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Technical Report No. 187

AMPHIBIOUS CARGO HANDLING ABOARD SHIP IN A SELECTIVE UNLOADING ENVIRONMENT

by

M. C. Dalby, M. B. Betts
B. J. Gibson and T. C. Cox

26 October 1970

Prepared for
Naval Ship Systems Command
(Code 03412B)
and the
Office of Naval Research (Code 463)
Contract N00014-70-C-0146

Distribution of this report is unlimited.

156

UNCLASSIFIED
Security Classification

DOCUMENT CONTROL DATA - R&D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1 ORIGINATING ACTIVITY (Corporate author)

Presearch Incorporated

2a REPORT SECURITY CLASSIFICATION

UNCLASSIFIED

2b GROUP

-

3 REPORT TITLE

Amphibious Cargo Handling Aboard Ship in a Selective Unloading Environment

4 DESCRIPTIVE NOTES (Type of report and inclusive dates)

Final Report

5 AUTHOR(S) (Last name, first name, initial)

Dalby, Marion C., Betts, Martin C., Gibson, Brenda J., Cox, Thaddeus C.

6 REPORT DATE	7a TOTAL NO OF PAGES	7b NO OF REFS
26 October 1970	152	7

8a CONTRACT OR GRANT NO.

N00014-70-C-0146

b. PROJECT NO

NR 259-081

c

d

9a ORIGINATOR'S REPORT NUMBER(S)

Technical Report 187

9b OTHER REPORT NO(S) (Any other numbers that may be assigned this report)

-

10 AVAILABILITY/LIMITATION NOTICES

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11 SUPPLEMENTARY NOTES

-

12 SPONSORING MILITARY ACTIVITY

Office of Naval Research
Naval Ship Systems Command

13 ABSTRACT

This report summarizes a study of a cargo management system dealing with the identification, location and control of cargo in amphibious operations in a selective unloading environment. Current cargo management techniques are reviewed, and advanced cargo management techniques at the ship and task force level are discussed. Because no firm doctrine exists for selective unloading operations, a hypothetical cargo management system is used as a framework for the analysis. This system is described in detail, and data processing considerations in such a system are discussed.

DD FORM 1 JAN 64 1473

UNCLASSIFIED
Security Classification

UNCLASSIFIED
Security Classification

14 KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Cargo Handling						
Materials Handling						
Amphibious Operations						
Information Systems						

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NR 259-081/9-22-69
NSSC 034--3412B-0-1016/9-30-69

SUMMARY

1. Advancing technology, improved hardware systems and evolving tactical doctrine promise major advances in amphibious logistic techniques. These techniques offer prospects of significant increases in military effectiveness by allowing seaborne forces to shoulder a substantially greater share of the logistic support conventionally provided by land forces. The force ashore might then devote fewer resources to support of itself, by reducing its shorebased supply structure, shorebased shops and repair facilities, shorebased maintainance stores, and reducing the number of combat troops needed for the protection and operation of such facilities.

2. The extent to which this seaward shift is feasible and productive will depend to a large extent upon highly responsive "retail" supply operations, moving cargo directly from amphibious ships to individual units of the landing force. These "retail" operations, in turn, call for advanced shipboard cargo management techniques which allow rapid, high-volume, selective offloading of amphibious cargo.

3. Selective unloading of this type represents a substantial departure from the combat loading/general unloading techniques generally employed today, and imposes broad new technical demands on cargo management. A cargo management system for selective unloading must encompass the physical handling of cargo within the individual ships to locate, identify, break out, strike up and dispatch supplies and equipment on a selective basis. In addition, it must produce, process and communicate the detailed information necessary to make the physical handling process responsive and productive.

4. In individual ships, the new cargo management system will require a central control agency in the ship to manage the total shipboard process, crews operating at the various levels in the various holds, capable of locating and breaking out the selected cargo, and

an overall ship's control system to monitor the cargo flow and to tie the various functional agencies of the ship together into an effective operational system.

5. While the physical handling problems are generally individual ships' problems, the information systems in individual ships must also be consolidated into a single total task force system, and integrated with supporting agencies outside the amphibious objective area. This overall system, operated from a central location such as the task force flagship, should perform eight key functions: (1) it should provide the system through which requests are received, and subsequent action traced until ultimate delivery; (2) it should monitor stock levels at supply points within the system; (3) it should maintain timely records of transactions; (4) it should reorder and reposition supplies as required to maintain desired inventory levels; (5) it should coordinate and schedule the movement of transfer vehicles; (6) it should coordinate the replenishment of ships supporting the logistic base; (7) it should furnish command information as desired; and (8) it should provide a reference system for supply item substitutes.

6. Although it may be feasible to operate a limited scale retail cargo management system using manual methods, it is apparent that far greater efficiency might be attained through the use of more advanced information processing techniques. These would facilitate five important system functions: (1) processing and communication of indiviudal requests for support, along with the attendant record-keeping; (2) the inventory control task to ensure timely reordering and optimum source selection; (3) management information system reporting as required by operational commanders; (4) decision-assist recommendations on complex logistic matters through the use of operations research techniques; and, when required, (5) assistance on coordination of the actions of other agencies in logistic support matters.

7. This report comprises a basic reference framework to assist in developing future research and development programs and programs to update and modernize existing hardware, so that individual efforts are integrated elements of an overall, advanced shipboard cargo management system.

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101. INTRODUCTION

This report summarizes a study of a cargo management system dealing with the identification, location and control of cargo in amphibious operations in the 1975-1985 time period. This investigation was carried out for the Naval Ship Systems Command (Code 03412B) under ONR Contract N00014-70-C-0146.

102. BACKGROUND

A. Evolving trends in amphibious assault operations are leading toward new approaches to logistic support of landing forces ashore. These new methods of logistic support were identified in a previous study performed by Presearch. 1/ That report, which documented the first phase of this project, examined in detail the evolving trends in amphibious operations and observed that the dominant trend through 1985 is logistic support from a mobile seabase. That study phase also developed generalized material flow patterns for an amphi-

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1/ Presearch Incorporated Technical Report No. 167, Requirements and Development Efforts in Amphibious Materials Handling, (U) 29 August 1969, CONFIDENTIAL.

bious operation, which were independent of operation size or type of support. The report on the following pages documents the second phase of the study and examines in detail the shipboard cargo management problem in the advanced environment.

B. In a separate, but closely related study effort, the Chief of Naval Operations and the Commandant of the Marine Corps, in May 1970 established the Seaborne Mobile Logistic System (SMLS) as a task of the Navy Marine Corps Amphibious Force (NAMAF) Study. 2/ That effort now constitutes the principal focal point of joint Navy-Marine Corps studies aimed at developing the concept for seabased logistic operations. The Marine Corps Development and Education Command and the Amphibious Warfare Board were tasked to conduct the SMLS Study. The Fleet Marine Forces and Amphibious Forces are also performing work closely related to this program. The framework for analysis developed for the report presented on the following pages relies heavily on advanced work performed by the SMLS Study Group under the guidance of NAMAF.

103. PURPOSE

The purpose of this report is to examine the shipboard cargo handling problems arising from "retail" type supply support of a landing force directly from amphibious ships. This report addresses

2/ CNO/CMC letter OP-340/Ser 639P34, Joint Navy/Marine Corps Study of a Seaborne Mobile Logistics System, (U), 6 May 1970, UNCLASSIFIED.

the impact of this type of support on problems of cargo control, identification, location and packaging which will affect amphibious logistics in future operations.

104. STUDY APPROACH

A. The approach taken in performing this study has been dictated to some extent by the status of the operational concepts involved. Since these concepts have not yet become doctrine, no definitive logistic system for the seabased environment yet exists. It was therefore necessary to hypothesize such a system to provide a framework for study and a context within which to examine the ships' cargo management problem. This hypothetical system, which is described in Appendix A is based largely on advanced study and operational testing performed to support the SMLS Study. Where necessary, additional details were filled in, on a logical basis, in order to provide an adequate framework for examination of the shipbased cargo problem in the new environment.

B. The text provides a review of current cargo management and loading techniques for contrast with the more advanced techniques. Using the hypothetical logistic system as a basis, advanced techniques are discussed for ship loading, physical handling and information flow. These are examined for an amphibious task force as a whole, and at the individual ship level. The task force level discussion centers around information flow necessary to control the overall cargo management problem, while the ship level discussion is concerned with both physical handling and information.

105. CONTENT

The following portion of this report, Section II, addresses the trends toward ship-to-user logistic support in amphibious assaults, and examines some of the factors inherent in such operations. Section III is a review of current cargo management and loading techniques, while Section IV discusses advanced techniques at the task force level. Advanced techniques at the ship level are discussed in Section V, and Section VI presents a general discussion of information processing requirements to support advanced cargo management techniques. Appendix A contains a description of the hypothetical logistic system developed as a framework for analysis in this report and Appendix B presents some quantitative factors in seabased logistics.

II. THE TREND TOWARD SHIP-TO-USER LOGISTICS IN AMPHIBIOUS ASSAULTS

201. GENERAL

Combat operations in Vietnam over the past several years are consistent with a trend toward increased direct, ship-to-user logistics. In that area, for example, the Special Landing Forces have made over fifty amphibious landings where virtually all logistic support facilities remained aboard the ships of the Amphibious Ready Group during the entire operation. Those were relatively small landing forces (reinforced battalions) which did not require a full scale logistic seabase. The operations, however, furnished an important precedent and underscored the feasibility of seabased logistic support for specialized operations.

202. EXPERIENCE WITH ADVANCED LOGISTIC TECHNIQUES

In a separate effort Marines of the III Marine Amphibious Force, in 1968 and 1969 developed a number of advanced logistic techniques which also relate to seabased logistic support. In the

northern provinces of Vietnam, intense combat operations of reinforced regiment size were launched, carried out and supported totally by helicopter, using rear area logistic support points. On some days cargo throughput was as high as 500 short tons, delivered to 20 to 25 different units. 1/ Although those were "dry land" operations, the tactical and logistic situation closely paralleled operations supported from a logistic seabase. Supplies were moved from a few major rear area supply points comparable to one or more cargo ships operating in a logistic seabase. Distribution was directly from these rear area points to the using units at the company, platoon or even patrol level. The Vietnam experience demonstrated that high volume, "wholesaler-to-customer" resupply is feasible and manageable. To support such operations directly from a logistic seabase, however, requires that ships' cargo management systems and hardware be capable of high volume cargo throughput, with loads packaged to optimize utility to the using unit.

203. HARDWARE AND SYSTEM TRENDS

Advancing hardware and systems already under development are progressing toward making such support more nearly attainable. Examples of these are the LKA-113 CHARLESTON Class ship, with greatly improved selective cargo handling features; the LCC-19 Class command ship, with advanced communication and data processing capability; the

1/ Dalby, M. C., Combat Hotline (U), Marine Corps Gazette, Volume 54, No. 4, April 1969, UNCLASSIFIED.

LHA, with a wide range of new capabilities from aircraft operation and maintenance to advanced cargo handling; near-term prospects of helicopters able to lift 18 tons and future prospects of 25 to 30-ton lift machines; air cushion surface craft to complement the helicopter and offer a new measure of speed and versatility in the surface ship-to-shore movement; and advancing computer techniques, with programs such as Detail Ship Loading (DSL) to compress the time-consuming task of ship loading for amphibious operations. Properly integrated, hardware and systems such as these offer prospects of major increases in shipboard cargo throughput, in addition to new capabilities in other logistic support areas such as shipbased equipment repair of landing force equipment.

204. CONTRAST IN CURRENT TECHNIQUES AND SEABASED LOGISTICS

The trend toward ship-to-user cargo movement is driven largely by the promise of a better support job with fewer resources. The possibilities are apparent when one contrasts the existing techniques and those that could be employed using seabased logistic support.

A. Under current doctrine, as described in NWP-22 and related publications, the first few days of an amphibious assault are characterized by a general unloading of ships and the beginning of a major buildup ashore of supplies, equipment and logistic support personnel. Supplies are deposited ashore and then distributed through a landbased system to the individual user. Depending on the size and duration of the operation, repair shops are set up ashore with their own stocks of spare parts. Transport,

service support and medical facilities are built up. This shorebased logistic complex is costly in personnel, vehicles and equipment to protect, store, move and dispense the supplies and services, but more important, it represents heavy costs in support structure that could be greatly reduced if cargo were dispensed to the users directly from the ships which were used to bring it initially to the objective area.

B. In amphibious operations taking greater advantage of ship-to-user cargo movement, general unloading might never take place. The ground elements need land only those items of supply and equipment which contribute directly to their combat effectiveness. Vehicles and materials handling equipment might remain aboard ship. Replenishment would flow directly from the ships to the using units. Troops ashore would maintain only minimum stocks of ammunition, food and water. Helicopters would deliver artillery ammunition, immediately alongside the individual pieces so that crews could break down the loads and serve the guns without additional handling of ammunititon. A landing force would take ashore only the vehicles needed, such as special communication, command and control and reconnaissance vehicles. Shipboard shops would repair unserviceable vehicles and equipment. With this expanded support from the sea, a landing force would substantially reduce its shorebased supply structure and would no longer require a sizable number of troops ashore to operate and protect such facilities.

C. This reduction in size of a landing force does not necessarily represent a net reduction in resources needed in the overall amphibious

task force/landing force structure. Support functions shifted from shore to ship would, for example call for substantial reorientation of existing approaches to shipboard cargo handling which would, in turn, call for some augmentation of shipboard support resources.

D. Under existing techniques, amphibious cargo is generally offloaded in a last-on-first-off sequence. Once the cargo is ashore, a relatively extensive cargo handling organization and structure is needed to sort, rearrange and generally manipulate the cargo so that supplies can be issued in response to the varying daily needs of the user. Redesign of the cargo flow channel to eliminate this shore-based process and assume the same function aboard ship means that last-on-first-off offloading is no longer satisfactory. Cargo must be available on a selective basis, so that the ship can issue specific cargo on demand.

E. Cargo anywhere in the ship must be accessible on a nearly random basis. Shipboard hardware must permit high speed, high volume physical handling from holds to transfer vehicles. Information systems must be able to accept specific detailed resupply requests from using units, record them, and perform all the steps necessary to convert the request into cargo dispatched. Further, it must do this with a high degree of reliability and accuracy, since a fast moving tactical situation ashore will tolerate few mistakes in type, amount and delivery destination of resupply loads. This demanding characteristic necessitates information flow which also encompasses rapid and highly reliable techniques for shipboard cargo identification and management in the physical handling process.

F. In summary, trends in several fields are converging to allow major advances in amphibious cargo movement in the midrange and long-range periods. Some of the operational techniques involved in seabased logistics have already been applied in Vietnam. On the technical side, automated information systems, greatly improved VTOL aircraft, advanced landing craft and ship design, combined with other improved hardware and command and control systems, can conceivably bring a new dimension to future Navy/Marine operations through significantly improved seabased support systems, especially amphibious cargo handling. These advances impose heavy new demands on such functions as shipboard cargo identification, location, access and standardization of packaging. The succeeding chapters of this report address these matters from a functional viewpoint, and outline a cargo management and information system adapted for ships conducting direct ship-to-user cargo handling operations.

III. A REVIEW OF CURRENT CARGO MANAGEMENT AND LOADING TECHNIQUES

301. GENERAL

According to current methods of operation, the sequence in which cargo is to be offloaded in the assault is set early in the planning phase, soon after specific units of the Landing Force are associated with specific ships of the Amphibious Task Force. At that time, the transport group of the Amphibious Task Force is divided into transport units, and these into transport elements, which represent individual ships. The Landing Force is divided into embarkation units, these units are divided into embarkation elements and the elements in turn into embarkation teams. An embarkation team is normally associated with an individual ship. Subsequent to issuance of the initiating directive, specific assignment of embarkation teams to ships is made and the preparation for embarkation of cargo begins. Embarkation officers from embarkation teams meet with ships' combat cargo officers to develop the detailed loading plans for cargo in the individual ships. By the time embarkation is complete, the cargo unloading sequence to be followed later in the assault is basically established.

302. TYPES OF LOADING

There are four general types of loading for amphibious operations; however, only combat loading is in common use today.

A. Administrative Loading

This loading type gives primary consideration to achieving maximum utilization of troop and cargo space without regard for tactical considerations. Equipment and supplies must be unloaded and sorted before they can be issued. Administrative loading is not suitable for most amphibious operations.

B. Commodity Loading

This involves loading types of cargo together, such as rations, ammunition or other particular commodities, so that each can be discharged without disturbing the others. This, again, is not generally suitable for amphibious operations.

C. Selective Loading

This type of loading envisions arrangement and stowage of supplies and equipment aboard ship in a manner to facilitate selective issue of items to units. In general, this represents an ideal arrangement; however, configuration and hardware limitations in older amphibious ships made selective loading feasible only on a very limited basis. For future operations, however, selective loading appears both feasible and practical, provided appropriate adaptations of current hardware or development of new hardware is accomplished. Such steps are the principal topic of this report.

D. Combat Loading

This type of loading envisions the stowage of equipment and supplies in a manner to conform to the anticipated tactical operation

of the organization embarked. Each individual item of cargo is stowed aboard ship so that it can be unloaded in the sequence which will most effectively support the planned scheme of maneuver ashore. Generally, combat loading dictates a last-on-first-off unloading sequence, based on operational predictions made weeks or months before the actual amphibious assault. Since neither administrative nor commodity loading is suitable, and because selective loading has not been feasible, combat loading may be considered the standard technique employed in current operations.

303. CHARACTERISTICS OF COMBAT LOADING

A. By nature, combat loading techniques impose severe limitations on offloading flexibility. In certain cases cargo can be moved selectively from special compartments or in specially loaded cargo units, such as ammunition stowed in special ordnance compartments, small items such as spare parts packed in special containers and cargo stowed on the squares of hatches. Such exceptions, however, do not represent a large share of the amphibious cargo, and it is generally accurate to say that cargo must come off the ship in the inverse order from which it was loaded.

B. This fundamental lack of flexibility tends to constrain the operation to the type envisioned at the time of embarkation. Subsequent changes to the concept of operations must be made within the framework of the preset cargo offloading sequence. A major advantage of this rigid loading method, however, is that there are virtually no cargo location and identification problems aboard ship. The unloading job is one of debarking cargo from the top until it has all been unloaded. The job

of locating, identifying and distributing cargo to specific using units is one that is done ashore by the Landing Force.

C. Although the cargo flow from a combat-loaded ship is relatively rigid once general unloading has commenced, the time of the decision to initiate general unloading is flexible and is made upon the recommendation of the landing force commander when he considers that the situation ashore is sufficiently consolidated to allow the large supply buildup on the beach. Prior to this time, the troops of the landing force operate from supplies carried ashore by individuals, cargo preloaded into vehicles landed early in the assault sequence, and from floating dumps or other increments set up as special "on-call" serials that are treated separately from the cargo designated for general unloading. The ship is expected to retain selective offloading capability of on-call serials remaining aboard ship. Movement of the remainder of amphibious cargo, however, proceeds automatically from beginning to end once the decision is made to start the movement.

D. No major specialized logistic agency is required for this process. The command to initiate general unloading, and the orders to land specific serials may be passed through normal command channels by the appropriate unit headquarters or command post. A Tactical Logistic Group (TacLog) may be established in the ATF to help supervise the debarkation, but its role is primarily one of monitoring and coordinating landing craft movement, and less often, one of actually controlling the movement of cargo and serials.

E. In sum, current techniques of managing cargo in amphibious operations generally involve a preset offloading sequence, in which cargo is issued selectively only after it is landed. Prior to that time, it is debarked according to the way in which it was loaded. Since there is little opportunity for selectivity in the process, no specific agencies are normally needed to control, regulate or alter the cargo flow.

F. Obviously, major reorientation of cargo management techniques is needed if cargo is to be offloaded selectively in a ship-to-user environment. The chapters that follow sketch the functional characteristics of a new cargo management system oriented toward this type of cargo flow, including the systems aboard individual ships and the higher level system to manage and coordinate the cargo flow among the individual ships of the Task Force.

IV. ADVANCED CARGO MANAGEMENT TECHNIQUES INVOLVING SELECTIVE UNLOADING: AMPHIBIOUS TASK FORCE LEVEL

401. GENERAL

A. A cargo management system which replaces general unloading techniques with selective, retail cargo distribution must function simultaneously along two dimensions. It must encompass the physical handling of cargo within the individual ships to locate, identify, break out, strike up and dispatch supplies and equipment on a selective basis. In addition, it must produce, process and communicate the detailed information necessary to make the physical handling responsive and productive.

B. While the physical handling problems are those that must be solved in individual ships, the information flow systems in individual ships must be consolidated into a single total system throughout the task force, integrated with supporting agencies outside the amphibious objective area. The following paragraphs address the functions of this larger information flow system which overlays the flagship and supporting ships.

402. INFORMATION FLOW AT THE TASK FORCE LEVEL

A. The flow of information among the ships of the Task Force and with the Landing Force should allow management of the complete

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cargo handling process including movement, packaging, and staging of supplies for delivery to the using unit. Depending on the operational situation this function may also include actual delivery of supplies, or the Landing Force itself may assume the delivery function. In any case, the task force cargo information system should trace the material handling process through to ultimate delivery to the user.

B. The information flow system should also monitor supply levels at the various supply points functioning under its control. Under most circumstances this would apply to those stocks in ships engaged in direct supply support of the Landing Force. It might also including operating, safety or emergency stocks held at other specially established stock points, including inactive, back-up stocks held by units of the Landing Force. Although stocks held by the Landing Force are not technically within the management control of the task force information system it is necessary to monitor stock levels at those points to provide a basis for related logistic decisions in the Task Force. To bring maximum effectiveness to the amphibious cargo movement, the system should perform six additional, related functions:

1. Maintain timely records of supply posture at key points throughout the supply system.

2. Reorder and reposition supplies as required to maintain desired inventory levels at designated points.

3. Coordinate and schedule the movement of vehicles, including ships employed in resupply and replenishment.

4. Coordinate the replenishment of ships designated to support the amphibious operation.

5. Furnish command information as required on detailed supply posture and usage rates.

6. Provide a reference system for supply item substitutes.

403. FUNCTIONAL AGENCIES

A. The information system described above must link the three principal participants in the cargo movement process: the user (landing force), the supplier/retailer (support ships) and a central cargo coordination center to furnish the linkage between participants and management of the total cargo movement process (flagship).

B. Existing doctrine does not require a specialized cargo management system of this type and none currently exists. Therefore, in order to examine the new functions required by an advanced shipbased, retail cargo distribution system it is necessary to define a frame of reference. The functional arrangement used here is keyed to a hypothetical total cargo management system reflecting a logical arrangement of tasks and relationships between the major participants in the process. This hypothetical system was developed to facilitate the analysis in this report and is described in detail in Appendix A. The essential elements of the hypothetical system, along with agency names were taken from the logistic control structure developed by the SMLS

study group and tested in amphibious exercise Escort Lion II in September of 1970. Although that structure was exploratory in nature and has not yet been adopted as a fully developed concept, it represents a realistic arrangement of the basic functions that must be performed in retail cargo distribution.

C. For convenience in the discussion that follows, the agencies representing the users in the landing force are called the FLCC (Forward Logistic Control Center), the cargo management agencies in the individual ships are called SLCC (Ship's Logistic Control Center) and the central cargo coordination center is called the LSC (Logistic Support Center). The basic organizational relationships between these functional agencies are discussed below.

1. Ship's Logistic Control Center (SLCC)

The SLCC's are the principal functional arms of the amphibious cargo management system, operating under the direction of the Logistic Support Center (LSC). While the LSC is the primary center for controlling and coordinating all major cargo movement operations of the Task Force, the individual SLCC's actually control the cargo handling. It is the task of the SLCC to receive requests from the LSC, to physically locate and manipulate the cargo, and to stage it and launch it by boat or aircraft enroute to the using unit, keeping the LSC informed of its actions. The SLCC is discussed in more detail later in the report.

2. Forward Logistic Control Center (FLCC)

The FLCC is the central point within the landing force which interfaces with the LSC and the seabased cargo management system. The FLCC is a streamlined facility manned and operated by the service support element under the LSC to assemble, assign priorities and relay cargo support requests from using units to the LSC. Using units will have liaison personnel in the FLCC.

3. Logistic Support Center (LSC)

The LSC is the primary agency for controlling and coordinating all cargo management functions of the amphibious operation performed by the ships of the Task Force. Thus the LSC is the logical central point to perform five basic functions:

a. Process cargo requests

The LSC would serve as the single coordination center within the task force to receive, process and fulfill requests for cargo support from using units. These requests would flow in from the FLCC, be processed, and passed to the SLCC for accomplishment, with the LSC coordinating the entire sequence.

b. Provide inventory control for the Master Amphibious Inventory

The LSC is a logical agency to exercise primary management control of the Master Amphibious Inventory. This master inventory, prepared during the embarkation phase, would be essentially a compilation of the individual ships' inventories, and would serve as a

master file for control of the ships' inventories and for control of the overall amphibious cargo system.

c. Provide management information system reporting

The LSC structure provides a convenient repository for a large amount of data which it would collect in the normal conduct of its operations. By carrying out inventory control and processing of cargo requests, for example, the LSC would have available detailed information on usage rates of individual items or classes of supply. Information of this type would be readily available depending upon the degree of detail to which it is useful to monitor operation of the cargo management system.

d. Provide decision-assist recommendations on complex logistic matters

The level of effectiveness of this function would depend directly upon the degree of advancement of the automatic data processing system used to support the LSC. A relatively advanced tactical shipboard installation, adequately programmed, could greatly enhance productive management of logistic resources through application of operations research techniques. For example, optimum routing of helicopters based at a variety of sites, making stops at a variety of other sites could be planned to gain maximum productivity per flight hour. Queueing techniques could be used to gain maximum productivity in situations which must mesh internal flow of cargo with external traffic control of transfer vehicles. Simulation models could be used to test proposed changes in tactical plans, to analyze time-distance

factors, cargo flow rates, and a wide variety of other logistic problems. This is a highly promising area in tactical ADP employment and one in which only limited work has been done to date.

e. Coordinate the actions of other centers in specified logistic support matters

Channeling of wounded to medical facilities in the Task Force is normally a function of a medical regulating network. The movement of wounded, however, may often require coordination within the overall task force logistic system. This is a process in which the LSC could provide an important coordination function. Other situations, such as a mass evacuation operation, or one involving movement of large numbers of refugees, might encompass medical service support, special cargo delivery, scheduling of logistic support transportation, engineer effort and security. Such situations would demand highly effective coordination of effort, a task falling logically to the LSC.

404. CARGO INFORMATION FLOW

A. Requests for support made to the LSC by using units would comprise the principal step that activates the retail cargo system and generates its transactions. Although the system would also be activated by command requirements for logistic information, decision assist or coordination of the activities of other centers, these are within the internal resources of the LSC and do not call for physical handling of cargo. Cargo support requests, on the other hand, call for the entire range of cargo handling and information resources and are therefore used below for illustrative purposes. This illustrative sequence is keyed to the

hypothetical amphibious logistic structure described in detail in Appendix A. It does not represent the only way in which cargo might be controlled and moved, but does reflect one logical arrangement of the fundamental processes necessary for retail cargo support, and one which is based on a total system view of the cargo flow processes.

B. The organizational structure ashore which initiates the cargo support request might comprise one or more FLCC, working directly with the LSC, or a number of FLCC dealing with the LSC through a central logistic coordinating agency set up by the Landing Force. In either case, however, the action taken by the LSC upon receipt of a request would be essentially the same. This process is illustrated in simplified form in Figure 4.1. Upon receipt of a supply request at the LSC, a task number would be assigned and this information passed to the FLCC to facilitate identification of the mission as it passes through the system. The LSC would next query the master amphibious inventory file for prospective sources for the desired items. If there is more than one source among the ships of the Task Force, the optimum source would be selected.

C. The request would then be passed to the SLCC in the selected source ship, along with any special instructions necessary. In passing, the request would still be identified by the task number originally assigned upon receipt at the LSC. Depending on the state of advancement of the data processing system serving the cargo management system, the SLCC would send periodic reports to the LSC advising status of the request within the ship. The next key step, however, would be the report by the SLCC that the particular task number is staged and ready for pickup and

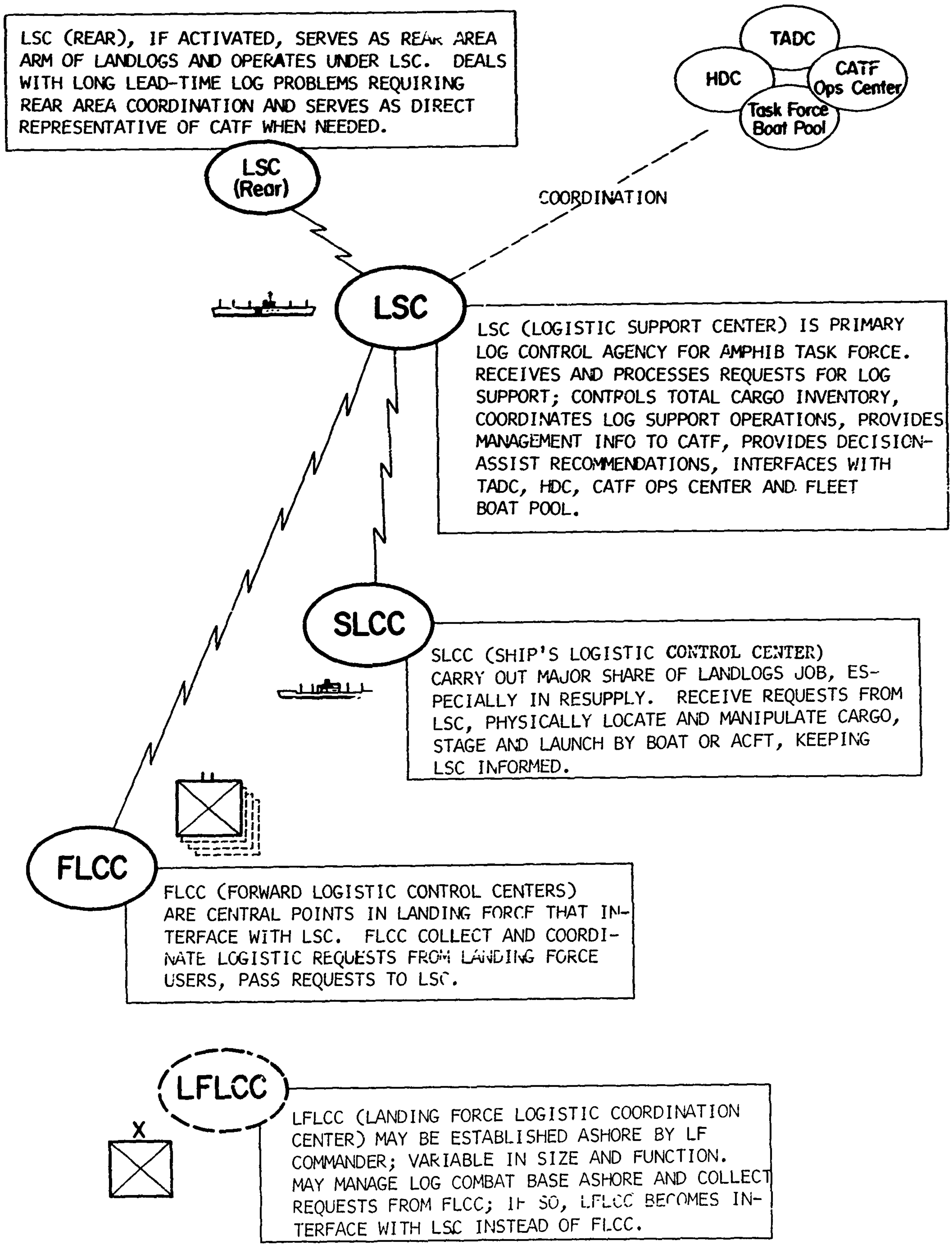


FIGURE 4.1

FUNCTIONAL AGENCIES

delivery. Details relating to processing of the request within an individual ship are described in more detail later in this report.

D. When the LSC is advised that a particular task number is staged and ready, it would dispatch an appropriate transfer vehicle or pass the transfer request to an external agency, such as the Helicopter Direction Center or Primary Control Ship, depending on the particular command arrangement for control of transfer vehicles. In either situation, the LSC would retain primary responsibility for tracking the request throughout the process until the user acknowledges that he has received it. There are several reasons for this single responsibility. First, it establishes one clear channel through which the FLCC can transact all its cargo business. Second, it reduces the possibility of system breakdown which could easily occur when responsibility passes from one agency to another. Finally, as the Fleet acquires progressively more capable shipboard data processing systems the LSC becomes more logically the single coordination center with the capability to monitor and control the detailed supply processes.

E. This single logistic responsibility in cargo requests would not mean that the LSC must necessarily assume responsibility for control of boats and helicopters. It does mean that the LSC must be aware of the progress of a request, so that if a disruption occurs in the flow, the LSC is able to initiate action to correct it or to cause the flow to resume by an alternate means.

F. After the SLCC reports a load staged and ready, and after the appropriate transfer vehicle has been dispatched, the next

step would be a report to the LSC by the SLCC that the load has been picked up and is on the way to the user. The SLCC has now closed out its action regarding that task number. When possible, the LSC should advise the FLCC that the load is on the way. The total process would be closed out when the load is delivered to the user and the FLCC reports that the load has actually arrived at its destination. At that time the originally assigned task number would be retired from the list of active tasks being controlled by the LSC.

G. The specific means of communicating the various messages throughout the process might vary greatly, depending on the particular hardware and information system in use, as will the techniques for documenting the key steps. The functional process, however, would remain essentially the same for a hybrid manual-automatic system, or for a highly advanced, fully automatic system that might be developed for the 1975-1985 period.

V. ADVANCED TECHNIQUES EMPLOYING SELECTIVE UNLOADING: INDIVIDUAL SHIPS

501. GENERAL

A. The following section describes a hypothetical advanced cargo system applicable to individual ships operating in a retail distribution environment. A general discussion of the basic tasks of such a system is presented first, followed by a more detailed discussion of the functional agencies and operational processes necessary for this system. Both the cargo issue and replenishment processes are traced to show material and information flow.

B. While the cargo problem at the task force level is primarily a matter of information flow, the selective unloading task in individual ships requires not only a highly effective information system, but also a physical handling system consistent with high-volume, selective movement of cargo. "High-volume" cargo movement in this situation does not imply a force-wide rate as high as that during a general unloading effort. It does, however, refer to the challenging retail distribution problem of combining selectivity with sufficiently high throughput in an individual ship to maximize responsiveness to customer demands, while minimizing the number of ships required to support any given size landing force.

C. An individual ship's selective unloading system should be viewed as a component subsystem of the task force cargo management system. Selective unloading might be employed on a total-support basis, or as a complement to other resupply means. The following discussions envision the extreme case of total seabased support in which individual support ships must operate at maximum cargo rates and are replenished periodically, as required, to maintain desired stock levels.

502. BASIC TASKS OF A SHIP'S SELECTIVE UNLOADING SYSTEM

A. The primary task of a ship's selective unloading system is to facilitate responsive supply support to landing force units. Responsive support requires that amphibious ships have the capability to break out, strike up and dispatch cargo in a manner somewhat different from the relatively limited selective unloading that is feasible today. The Amphibious Ready Groups routinely provide seabased supply support to the Special Landing Forces. However, those are relatively small scale operations, measured in volume of cargo moved, rarely calling for more than 8 to 10 short tons per day. The new demands on support ships imposed by selective unloading stem primarily from the volume of the cargo involved. Throughput volume, in the advanced environment of selective unloading, becomes a principal measure of support effectiveness. As throughput rates per ship increase, fewer ships might then be needed to support a given size landing force. One ship, for example, capable of sustaining a retail issue rate of several hundred tons per day, with a selective unloading capability at those rates, might be able to assume the major share of the resupply burden for an entire

landing force of brigade size. The primary task, therefore, of a ship's selective unloading system in the future environment is to make possible high-volume issuing of cargo on a "retail" basis.

B. The second basic task of an individual ship's system is a corollary one: to facilitate high-volume and precisely controlled replenishment to sustain high-volume retail issue. The two tasks, issuing and replenishing, join together to determine the throughput rate that can be achieved. Like selective unloading, at-sea replenishment is in no way a new technique and is practiced daily by fleet units. The large volume of cargo movement, however, required in a retail amphibious resupply on a prolonged basis, adds new problems to the old techniques.

C. Replenishment of a CVA today routinely entails movement of a hundred or more tons per hour, a high figure, but ship classes more likely to be designated to provide supply support for amphibious operations are not now accustomed to intake in such volumes. An LKA, for example, serves as "customers" its own crew, the needs of the ship itself and of any embarked troops, and is replenished on that basis. In a retail distribution environment the customer is now part or all of the landing force maneuvering ashore. This means that replenishment would now have to accommodate the needs of troops numbering perhaps in the thousands, who require the full spectrum of combat cargo support. When only serving itself and embarked troops, the ship would not normally be obliged to shift cargo extensively in the cargo holds. When providing retail support the great share of the replenishment would flow into the cargo holds to replace cargo issued earlier, requiring almost continuous shifting of cargo, either in the receiving or issuing

process. Operation in the retail mode, therefore, introduces new types of requirements in receiving, monitoring, cataloging and stowing large volumes of retail cargo. At this point in time, it appears that containers will play an important role in future ship-to-ship transfer of cargo; however, much remains to be done in this area. This topic is discussed in more detail in Section 505.D.2 of this report.

503. FUNCTIONAL AGENCIES IN A SHIP'S SELECTIVE UNLOADING SYSTEM

The following paragraphs describe each of the key agencies, and its function in selective unloading, found in an individual ship.

A. Ship's Logistic Control Center (SLCC)

The Ship's Logistic Control Center (SLCC) is the primary agency for controlling and coordinating all logistic functions of the amphibious operation which are furnished by that ship. Personnel to man the SLCC would likely come from both the ship and the landing force, since a large share of the job of physical handling of material in ships falls logically to landing force representatives working in the ship. The SLCC replaces the existing agency known as Debarkation Control, and key individuals such as the Combat Cargo Officer will function from this center.

B. Hold Crews

Hold Crews are responsible for the physical location of cargo in storage and during its movement within the ship. These crews

might be variable in size and number per ship depending on the particular ship and operation involved. A single crew might consist of a hold captain (a senior petty officer), one or more forklift or transporter operators, one or more storekeepers, and one or more other individu: to assist in physical manipulation of cargo. Hold crews would likely be made up of both ship and landing force personnel.

C. Staging Crews

Staging Crews would be made up of specifically assigned individuals and, like the hold crews, would include both ship and landing force personnel. Staging crews would be located at designated staging points in the ship to receive cargo from one or more hold crews and to make preparations for debarkation of cargo. In some situations staging might be accomplished at debark stations, rather than at intermediate staging points, in which case debark crews would perform the staging crew function. In replenishment operations the staging points would become cargo breakdown points where loads taken aboard would be broken down for distribution and stowage. The staging crews would perform those functions, assisted by the hold crews.

D. Debark Crews

Debark crews would man the ship's debark stations, which are the positions in the ship designated for transferring cargo loads from the ship to transfer vehicles, either surface craft or aircraft. The debark crews would perform any final steps remaining to ready the loads for debarkation, and would transfer the loads into the assigned

transfer vehicles. In certain situations in which some staging is accomplished at the debark stations, staging crews would be absorbed into the debark crews. The term "debark station", as used here, refers to the debark stations which now exist in amphibious ships. In this sense the flight deck spots are also treated as debark stations. During replenishment operations debark crews would become replenishment crews, performing the cargo debark function in reverse.

504. A SELECTIVE UNLOADING SYSTEM IN OPERATION

A. CARGO ISSUE PROCESS

1. The selective unloading system in an individual ship would be activated upon receipt of a supply request by the Ship's Logistic Control Center (SLCC) from the Logistic Support Center (LSC). This sequence is shown in Figure 5.1. The supply request would contain an identifying task number, identification and description of specific items desired, and any special packaging or handling instructions or additional information that may be necessary.

2. On receipt of this request the SLCC would determine the locations in the ship of specific items requested, the accessibility status at these locations, which debark stations and staging areas can be used and whether any special internal handling instructions are necessary. With information to make these determinations taken from the individual ship's inventory, the SLCC would select the hold crews, staging and debark crews to act on the request.

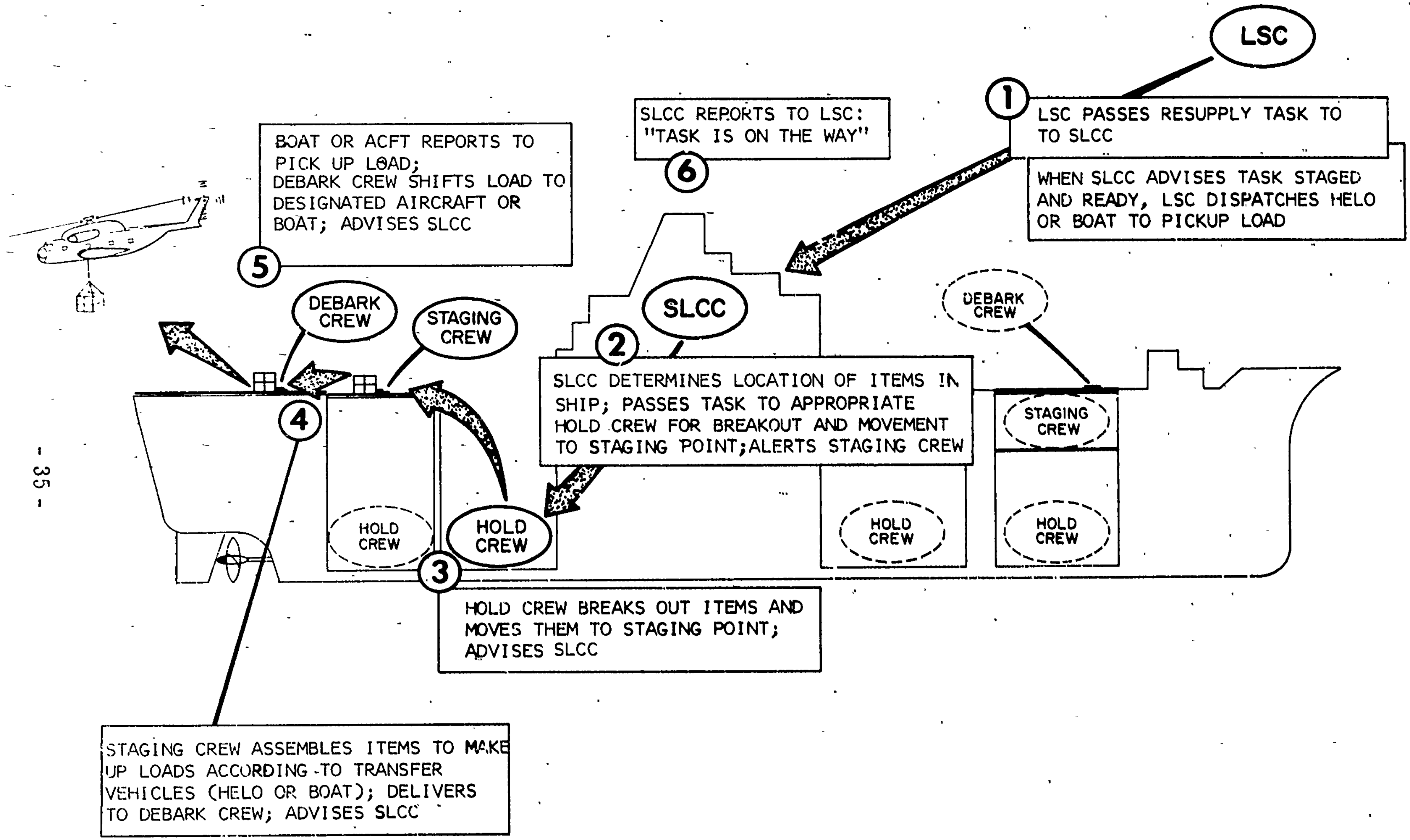


FIGURE 5.1

SHIP'S CARGO MANAGEMENT SYSTEM OPERATION

3. The SLCC would then pass initial orders to appropriate crews and would document the transaction in a manner to facilitate follow-up. Check points would be established so that cargo movement status could be maintained on a near real-time basis. An estimate of time for pick-up would be made and reported to the Logistic Support Center so that a transfer vehicle may be dispatched for pick-up.

4. The order issued to an individual hold crew by the SLCC would contain an identification and description of those items to be supplied from that hold, and internal handling instructions as appropriate. This order would also contain the precise location of each item, using a location address system designed to facilitate the physical location of the item by the hold crew. The location address would be obtained from the individual ship's inventory by the SLCC, or from the Master Amphibious Inventory by the LSC and passed to the SLCC.

5. After being located, individual items would be broken out and assembled into cargo unit loads by hold crews for movement to the designated staging area. Assembly would include whatever packaging of multiple item loads is required for internal movement. Assembly also would include some form of cargo unit load identification which readily conveys the task number, staging area and debark station information to materials handling equipment operators, staging and debark crews. When the load is prepared and identified, the hold crew would initiate movement to the designated staging area and report this movement to the SLCC and to the designated staging crew.

6. The order issued to the staging crew would contain identification, description and designated cargo holds for all items that comprise the specific task, designated staging areas and debark station, and any appropriate special instructions. The staging crew would receive and check assembled loads from the designated cargo holds and would prepare tasks for debarkation. Staging may require further packaging for external movement via transfer vehicle. When the staging crew determines that the task is ready for debarkation, the task would be moved to the debark station. This movement would be reported to the SLCC and the designated debark crew by the staging crew.

7. The orders issued to debark stations would indicate which tasks should be picked up by what type transfer vehicle at what time, and a sufficient description of the task to facilitate preparation. Debark crews would receive staged tasks, report to the SLCC when loads are ready for pick-up, and load and dispatch transfer vehicles as directed by the SLCC. If two or more tasks are to be loaded into one vehicle, the SLCC would inform the debark crews, who insure that all transfer vehicles contain all the necessary tasks.

8. The SLCC would report the dispatching of tasks to the LSC. The SLCC would also initiate action to update both the individual ship's inventory and the Master Amphibious Inventory.

B. Replenishment Process

1. The replenishment process would begin with the determination of requirements by the Logistics Support Center (LSC).

Requirements would be determined by querying the Master Amphibious Inventory for quantities equal to or less than reorder quantities, and by reviewing unfilled requests, or other standard inventory control techniques. The role of the Ship's Logistic Control Center (SLCC) in the determination of requirements would be to insure that accurate inventory update reports have been made to the Logistic Support Center (LSC) during resupply operations. Beginning with the receipt of cargo on-board, whether via underway replenishment or transfer vehicle, the replenishment process would be the supply process in reverse with only minor modification.

2. The storage locations for replenishment items would be determined by the Ship's Logistic Control Center (SLCC) from the list of incoming supplies and the current individual ship's inventory. Staging areas for each replenishment operation would be established in locations determined by the volume of cargo to be received and its intended distribution in the ship. Incoming cargo would be moved from replenishment stations to staging areas as it is received on-board.

3. Staging crews would identify, label with storage location identification and assemble for movement to cargo holds the incoming cargo. These actions may require the breakdown and reassembly of some cargo loads by the staging crews. With cargo loads assembled and identified, cargo would be moved to the holds.

4. Hold crews would receive incoming cargo, physically locate the designated storage location for each item, place items in storage and make reports to the SLCC.

5. The SLCC would report completion of the replenishment operation to the LSC. The final action in the replenishment process, as in the supply process, would be the updating of the individual ship's inventory and the Master Amphibious Inventory. Updating action would be initiated by the SLCC.

505. IMPACT OF SELECTIVE UNLOADING ON CURRENT CARGO MANAGEMENT TECHNIQUES

A. GENERAL

The shift from a general unloading cargo handling concept to a retail, ship-to-user concept calls for a selective unloading capability, which implies new demands on the cargo management system. It is appropriate now to examine specifically what those new demands are. It should be emphasized at this point that differences between the general unloading and retail approach are mostly relative in nature. It is not accurate to say that a general unloading approach absolutely precludes any selective unloading. As a matter of doctrine, combat loading, which implies a general unloading approach, takes maximum advantage of selective unloading measures to the extent that this is feasible. Also, in the case of a ship configured and loaded to optimize selective unloading, not all cargo is actually available on a selective basis. Thus the differences between the two techniques become a matter of degree: problems such as specific item location and identification, which were minor in a general unloading environment, become extremely

important in a selective unloading environment. Problems such as comparative accessibility of types of cargo, which often are important in a general unloading situation, become relatively unimportant in ships loaded to allow selective offloading of cargo.

B. LOCATION IDENTIFICATION

1. A dominant consideration in selective unloading is the precision and timeliness with which a desired item or type of cargo can be pinpointed in the individual ship. Under current concepts, information in this detail is not of paramount importance, since most of the cargo is destined to be unloaded and sorted on the beach. Exceptions are on-call serials, but these are more often large and easily identifiable items or loads, few in number that are accorded special handling. In a selective unloading situation, the major share of the total cargo in the ship might be viewed as on-call cargo, and the problem therefore becomes different.

2. The ease with which specific items or cargo types can be located in a loaded ship under current concepts depends largely on the concern that the combat cargo officers and embarkation officers have attached to this problem. As a minimum, the combat cargo officer can locate the hold and deck on which a specific load is located, but he can do this only after a detailed examination of the ship's loading plans. In some special circumstances, he might be able to pinpoint a load in a specific spot in its compartment. In general, however, it is only possible to identify a unit load according to compartment, but not by location in that compartment. In compartments where many unit loads might be stowed in several layers, knowledge of the compartment does not

provide sufficient information to allow location of a specific cargo unit without considerable shuffling of cargo, a measure which is tedious and time consuming.

3. A capability to offload specific cargo units on order calls for a far more streamlined and precise means of identifying the physical location of cargo units in the ship. Cargo handling personnel must know where units are located, even those "buried" under other units, with sufficient precision to make cargo shuffling a directed rather than random effort. Besides carrying cargo unit location to this degree of precision, loading documentation should also be formatted to make the initial record search a prompt and effective operation. In sum, selective unloading calls for considerably more sophisticated techniques of marking cargo than are currently in use and requires recording the cargo's precise location in the ship, as well as assembling and formatting this information to facilitate determination of the location.

C. CARGO IDENTIFICATION

Closely related to the problem of determining the precise location in which a specific cargo unit is located, is the problem of physical identification of the cargo. It might be expected that cargo will be handled in loads containing several varied items or that smaller prepackaged cargo units might be separated from unit loads for retail issue. This requirement emphasizes the importance of appending some label or marking to cargo during both stowage and movement. This cargo identification problem requires not only identification of specific items in storage but also a dependable means of physical identification of individual loads as they pass through the physical handling process. These problems are discussed in more detail below.

1. Item identification in stowed units

In order to be effective in retail cargo issue, the selective unloading system should have the capability for issue of items smaller than embarked cargo units. A principal example of this would be spare parts for weapons, vehicles or electronics equipment. Such items required by units of a landing force might be packed in walk-in spare parts bins, in other specialized packaging, or simply in palletized units made up of smaller packages. In those cases the selective unloading system must facilitate a standard means of describing such items, in addition to facilitating location identification in the ship. It appears that Federal Stock Number may prove to be the most convenient means of labeling these smaller items. On the other hand, long complex Federal Stock Numbers may be less appropriate than some other more streamlined method of item identification since supply requests will probably originate ashore from battalion level. This is a problem of considerable importance in selective unloading and one which will likely require additional study by both operational and technical agencies. In any case, however, the selective unloading system must encompass a suitable labeling and description system for small specialized items.

2. Continuous identification during the physical handling process

In a retail cargo issue situation, requests submitted by individual units of the landing force ashore will frequently consist of more than one commodity, and will likely have the appearance of a shopping list rather than a request for a quantity of a single commodity. In filling requests from these shopping lists, ships' cargo handling systems will find themselves required not only to pinpoint a number of different

items at different locations in the ship, but also physically to assemble those smaller blocks of cargo into single packages which respond to the user's shopping list. This means that the physical flow of these sub-units of cargo must be precisely and efficiently controlled, through a multi-staged process and along different paths in the ship. Material handling equipment operators must be aware of what is being handled and where it must go. Personnel performing final assembly and staging steps must be able to identify readily the destination and special handling instructions related to a particular package. It is apparent that this potentially confusing and inefficient process requires that packages have a unique physical characteristic which readily imparts specific information such as request or order number, designated staging area and intended debark station. Such identification must support the internal flow direction and serve as a communications convenience in directing external flow.

D. PHYSICAL HANDLING

Selective offloading and replenishment require that individual items be physically accessible in nearly fully loaded ships for break-out, strike up and debarkation, capabilities which are functions of ship configuration, cargo packaging and the particular loading concepts applied. These three key elements are discussed in more detail below.

1. Ship Configuration

a. For amphibious ships to respond to supply demands of selective unloading, they must be configured so cargo can be broken out of any one space regardless of the load condition of the other spaces: so large quantities of such items as ammunition and rations can be broken

out and discharged rapidly, and so large numbers of small items such as repair parts can be broken out without excessive effort. These actions require cargo spaces with multiple and varied types of openings, elevators or vertical conveyors to reach all levels in the ship independently, and fork lift trucks and other types of horizontal flow equipment of various sizes.

b. The older amphibious cargo ship types, such as the World War II vintage LKA's are generally configured like merchant hulls of the break-bulk type. The hull is divided fore and aft into a number of separate holds, accessible for cargo only through large hatches that penetrate from the Main Deck downward through several lower decks to the bottom cargo deck. In loading, as lowest decks are filled, hatch covers are installed, becoming a part of the deck above. As a deck is filled, the hatch cover is installed on the deck above and the sequence continues until all the compartments are filled, from bottom up, and the main deck hatch cover closes off the top hold. Boats are then loaded and secured on top of the main deck hatch covers. It is this basic configuration that generally dictates the rigid offloading sequence that is established when an older amphibious cargo type is combat loaded. Hatches provide the only effective cargo access and vertical cargo flow is provided by booms and winches working above the cargo loads. When landing craft are finally loaded aboard on the upper deck hatches, all cargo is essentially "locked-in". This method of loading offers high utilization of cargo space, and as long as operational doctrine calls for general unloading in a rigid preset sequence the lack of selective offloading capability does not present an operational problem. This is not true in a more advanced logistic environment in which the capability to offload selectively is of far greater importance.

c. The newer ships constructed specifically for amphibious operations, such as the LPH, LPD and LKA-113 Classes which have already joined the fleets, and the LHA which is programmed, have been designed to provide greatly improved cargo stowage and handling capabilities. Cargo spaces have been designed specifically for amphibious cargo movement and there are no "deep holds" that require break-bulk type stowage. The term "deep hold" as used here refers to certain of the holds in the older ships which are more than ten feet deep. This deep space configuration has several major disadvantages. To utilize the maximum amount of available cube, cargo must be stowed in more layers than are desirable; in the case of pallets, this means more than two layers. Stowage in deep holds invites damage to the lower levels of pallets. Shoring and dunnage are required, and the deeper loads are effectively locked in until the upper layers of cargo are removed.

d. In the newer ships, equipment has been provided for mechanized handling of unitized cargo to reduce requirements for manhandling cargo. All of the new ships have at least one improved access to each cargo space: access trunk and inclined ladder, elevator, vertical conveyor, vehicle ramp, quick action hatch cover, fork lift truck access, cargo transporter or a combination of these. There is, therefore, a higher degree of cargo flow capability into and out of most of the individual spaces in those ships without regard to the cargo load in the other spaces. The latest of the new amphibious ships to join the fleet, the LKA-113 Class, is especially significant in the area of selective offloading capability. It is useful therefore to contrast cargo flow configuration of the LKA-113 Class with the older LKA-112 Class.

e. Figure 5.2 exhibits simplified profiles of the LKA-112 and 113 Classes. Among the obvious differences is the relative consistency of cargo space heights in LKA-113 ships compared to the LKA-112. In the LKA-113, there are no deep spaces. Effective utilization of the three deep spaces in the LKA-112 requires break-bulk type loading and manhandling of cargo. In LKA-113, stowage can be accomplished without the space loss and additional cargo handling complexities normally created by deep hold stowage in the older ships.

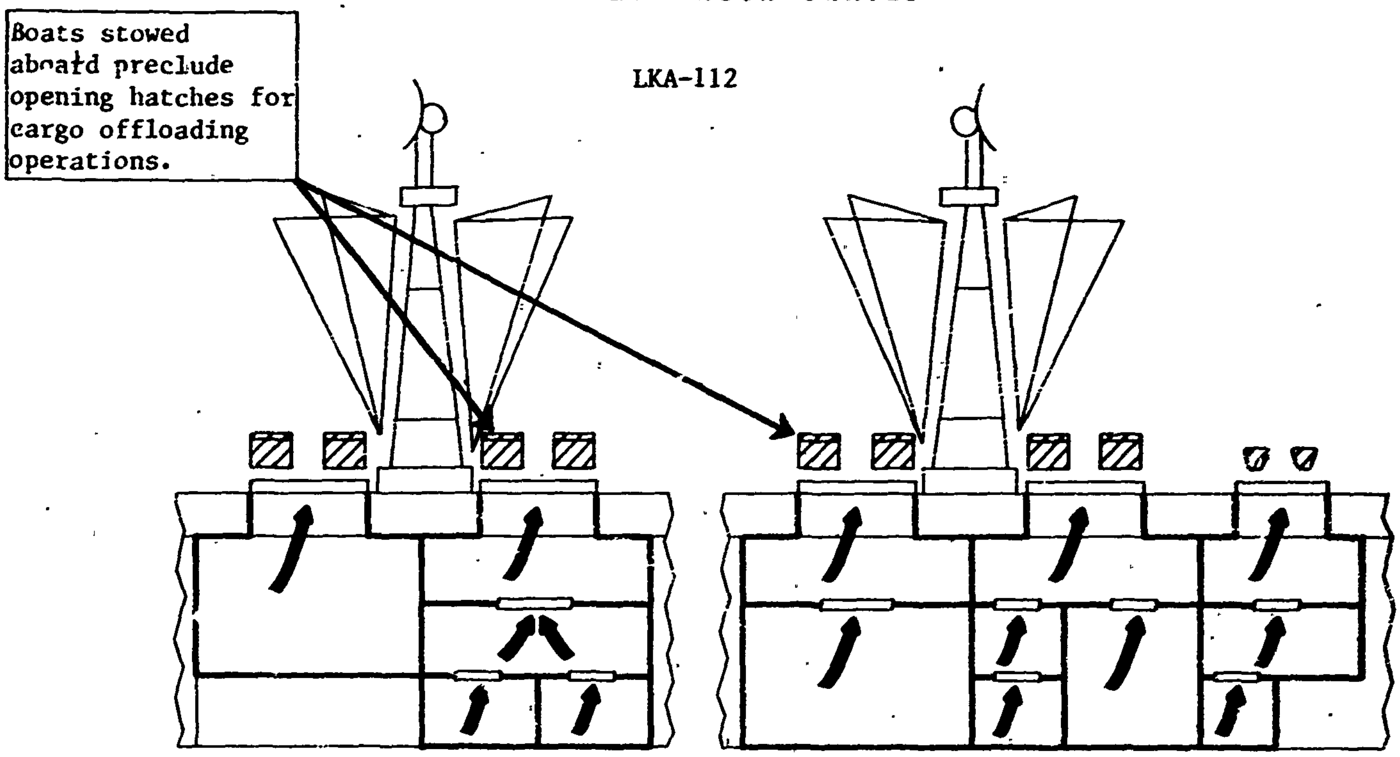
f. The second deck area in the LKA-112 is used for ship's crew and troop living and is not available for cargo. In the LKA-113 crew and troop living spaces are located in the midship portion of the ship, leaving the second deck area in the cargo holds available for cargo. As a result of these characteristics, the cargo capacity of LKA-113 is approximately twice that of LKA-112, even though the ship itself is only slightly larger. This is apparent in the figures displayed below.

LKA-112/LKA-113 COMPARISON [1]

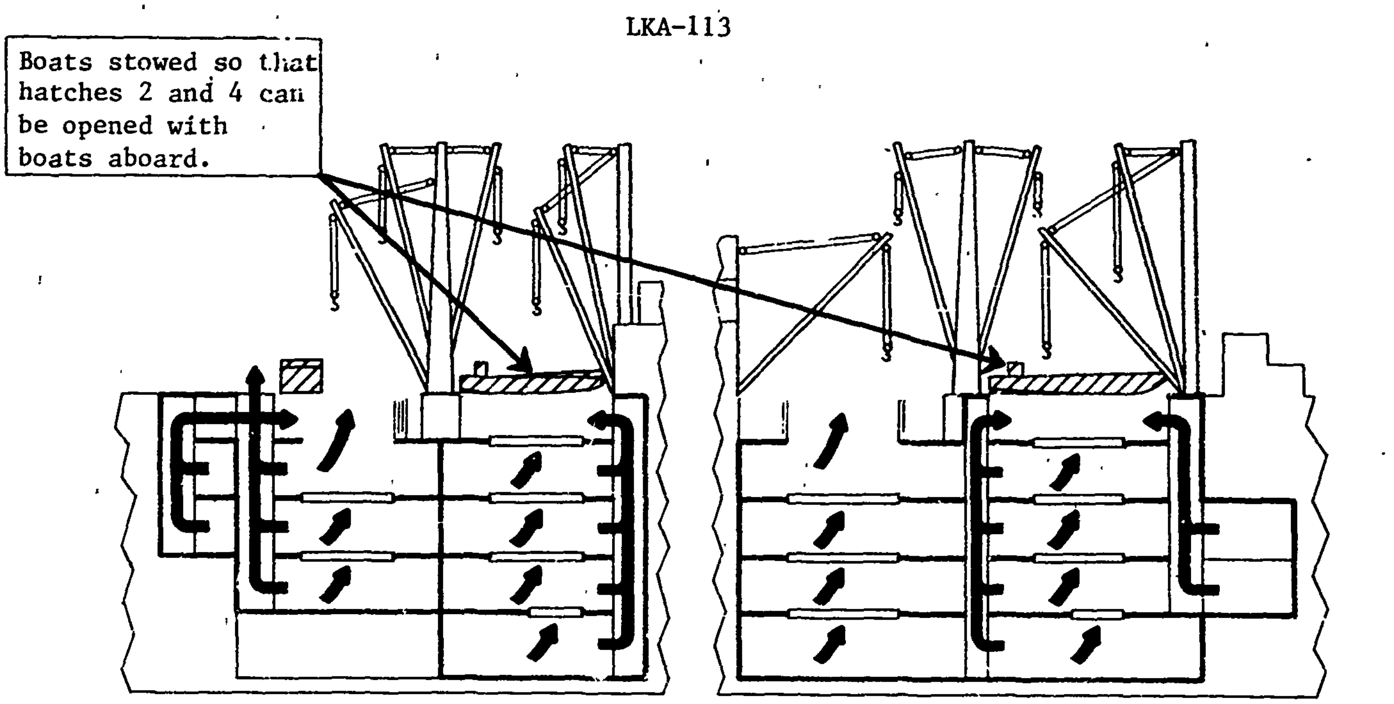
	Length, ft	Beam, ft	Troops	Vehicle Square, sq ft	Cargo Cube, cu ft
LKA-112	564	76	322	19,100	40,290
LKA-113	575	82	226	37,640	69,130

Note: Figures above contain 80% square and 75% cube broken stowage factors.

[1] Amphibious Warfare Board, Report on AWB Project No. 65-01-68, Ship Capacity Study, (U), September 1970, CONFIDENTIAL.



Ship is unloaded by opening hatch cover, unloading space below, opening next level hatch cover, unloading that space, etc.



Cargo elevators furnish access to all levels (except Hold 2) without opening hatch covers. As hatches are opened, both hatch and elevator furnish access to cargo.

FIGURE 5.2

SIMPLIFIED CARGO FLOW PROFILES OF LKA-112 AND LKA-113

g. In the LKA-113 Class, the hatch covers to all spaces except the lower levels of Holds 1 and 3 are power actuated accordion type. This allows any one to be opened in about 2 minutes, which contrasts sharply with about 10 minutes required to open and start to work cargo in the LKA-112 Class and about 30 minutes per hatch for the other older LKA's. Each hold in the LKA-113 is served by two 15 ton booms which operate in the swinging boom mode at speeds comparable to yard and stay speeds in older ships, a measure which more than doubles the cargo handling capability of each of those holds. In the LKA-113, a 70 ton boom forward serves Holds 1 and 2. A 70 ton boom aft serves Holds 3 and 4, and can lift loads from Hold 4 or the Main Deck to the Helicopter Platform. Holds 1 and 3 are additionally served by 40 ton booms.

h. In addition to hatch access, all cargo spaces except the 4 spaces in Hold 2 have independent elevator accesses. Elevators 1, 2, 4, and 6 can handle loads up to 5' by 5' by 6' 10" and weighing 4000 pounds, and have access to each cargo level and to the Main Deck. Elevator 3 serves only lower Hold 3 which is specially configured for drum petroleum products. Elevator 5 can handle loads up to 8' by 12' by 6' 10" and weighing 12,000 pounds, and has access to each level in Hold 4, the Main Deck and to the Helicopter Platform. Other significant characteristics of the LKA-113 Class are:

(1) Landing craft stowage is designed so that the main deck hatch covers of Holds 2 and 4 can be opened for cargo handling with landing craft stowed aboard.

(2) The Main Deck is configured such that fork lift trucks with standard palletized cargo loads, jeeps and other small vehicles can travel directly aft from forward hatches and elevator openings to the Helicopter Platform on the stern.

(3) Access trunks, inclined ladders and doors provide independent walk-in access to each cargo space, primarily for administrative purposes, but with an important potential usefulness for small, specialized item stowage, such as for repair parts and tools.

(4) Some of the characteristics of the LKA-113 Class are also present in the LPH and LPD Classes and are planned for the LHA. There are no deep cargo spaces, for example, such as those found in the converted merchant types. All cargo spaces have a means of independent cargo access via elevator or vertical conveyor; many spaces have multiple access provided by both elevators and conveyors, or elevators and vehicle ramps; equipment has been provided for mechanized or unitized cargo handling, and each space has an independent walk-in access.

2. Cargo Packaging

a. Considerable work has been done on amphibious cargo packaging in relation to physical handling of cargo aboard ship. This field, however, is of such fundamental importance to amphibious cargo movement that it tends to shape the entire process. Problems in standardization of military cargo packaging are essentially the same as those facing commercial users. Packages optimized for

certain purposes become largely unsuitable for other purposes. Thus it is extremely difficult to specify the ideal all-around package or family of packages.

b. The military problem might be illustrated as follows: the ultimate user of amphibious cargo is probably an individual unit of the landing force, for whom the ideal package is small enough for him to carry, to consume immediately or to issue on the spot. Large containers pose serious handling problems for him, and a retail cargo issue system, which requires him to expend special effort in handling deliveries, is of doubtful value. From the shipboard standpoint, the larger package is far more productive. The largest package still compatible with a ship's cargo handling equipment is generally the most efficient. Since amphibious shipping is virtually always at a premium, cargo handling techniques that allow better use of assigned shipping are to the best interests of all parties in the operation. These circumstances lead essentially to a situation in which the user optimum is the smallest feasible package while the carrier optimum is the largest one feasible. Although not invariably true, this is the general framework of the problem of standardization of packaging.

c. An oversimplified solution to this problem, would be a compromise in which cargo is prepared and embarked in large size containers, since it is more likely that embarkation would be under non-combat conditions where commerical techniques might be suitable. After transport to the amphibious objective area, the cargo would then be broken down into packages suitable for the specialized needs of the user. An approach along these general lines may ultimately

prove to be the best all-around answer, but this solution too, is characterized by complications. Cargo breakdown and repackaging aboard ship is costly in time, effort and space. For the most part, effective techniques for accomplishing this have not yet been developed. The overall problem of standardization of packaging of amphibious cargo is one of finding one, or a few solutions that represent the best compromise between almost diametrically opposing needs.

d. The fact that the ideal answer to standard packages has not yet been developed does not mean that considerable progress has not been made toward a solution. Important work has already been done and other work is now in progress. In 1968, a report was published by the Marine Corps Supply Depot, Barstow, California, on the Field Warehouse concept. [2] This work is important for development of techniques for handling small, low usage items, such as repair parts and tools, since it developed a method for loading such items in CONEX containers in a manner that would provide rapid access to individual items. The Naval Civil Engineering Laboratory, Port Hueneme, California, analyzed a Master Pallet concept, where two or more standard pallets are loaded onto a larger pallet, in the beach environment. [3] The San Francisco Bay Naval Shipyard analyzed

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[2] Markell, Capt. Elliot R., II, USMC Field Warehouse Concept, (U), Material Division Marine Corps Supply Center, Barstow, California, 1968, UNCLASSIFIED.

[3] NCEL Technical Note N-1039, Beach Materials Handling, (U), September 1969, UNCLASSIFED.

the Master Pallet concept in ship to craft cargo transfer operations.[4/] The Joint Technical Coordinating Group for Containerization is developing the concept of a Modular/Intermodal container, involving small containers of standard pallet load size which can be handled individually or coupled together to form a standard 8' by 8' by 10' commercial size container.[5/] All of these efforts are significant since they tend to shed additional light on the two opposing needs: improved efficiency from the standpoint of shipboard cargo handling and the need to improve responsiveness of the system customer. It is important to recognize, however, that these important steps still leave much to be solved in a critical and challenging problem area.

e. The new cargo handling features in ships such as the LKA-113 represent major improvements with respect to cargo handling; however, the new configurations tend to reduce the flexibility in usable packaging. Elevators, conveyors, access openings, etc., are designed to accommodate specific cargo packages, most often of pallet size, and load/equipment compatibility problems exist in new ships that did not exist in the older ships. The extent of this situation can be seen in Figure 5.3. It may be noted that in a number of cases, the newer ships offer narrower load/equipment compatibility than the LPA and older LKA class ships. This situation tends to constrain future decisions on standardized packages.

4/ San Francisco Bay Naval Shipyard, Technical Report H 19-69, Analysis of Cargo Pallet Concept, (U), 30 June 1969, UNCLASSIFIED.

5/ Information provided by Mr. C. Emberger, Chairman, Joint Technical Coordinating Group for Containerization, 14 November 1970.

Type of Load	Load Size l" x w" x h"	Ship Type					
		LHA	LPD	LPH	LPA	(old) LKA	(113) LKA
Pallet Loads (Std. Load 2,000 lbs)	52 x 43 x 43	Compatible	Compatible	Compatible	Compatible	Compatible	Compatible
Pallet Loads (Half 463L)(4,000 lbs)	54 x 88 x 48	Compatible	Partially Compatible	Compatible	Compatible	Compatible	Compatible
Pallet Loads (Half 463L)(8,000 lbs)	54 x 88 x 88	Conditionally Compatible	Potentially Compatible	Potentially Compatible	Partially Compatible	Partially Compatible	Partially Compatible
Containers (Half Conex)(10,000 lbs)	51 x 75 x 83	Conditionally Compatible	Potentially Compatible	Potentially Compatible	Partially Compatible	Partially Compatible	Partially Compatible
Containers (Conex)(10,000 lbs)	102 x 75 x 83	Conditionally Compatible	Potentially Compatible	Potentially Compatible	Partially Compatible	Partially Compatible	Partially Compatible
Pallet Loads (Air Force 463L)	108 x 88 x 48	Conditionally Compatible	Potentially Compatible	Potentially Compatible	Partially Compatible	Partially Compatible	Partially Compatible
Pallet Loads (Air Force 463L)	108 x 88 x 88	Conditionally Compatible	Potentially Compatible	Potentially Compatible	Partially Compatible	Partially Compatible	Partially Compatible
Containers (New Conex)(10,000 lbs)	80 x 96 x 96	Conditionally Compatible	Conditionally Compatible	Conditionally Compatible	Partially Compatible	Partially Compatible	Partially Compatible
Containers (40,000 lbs)	240 x 96 x 96	Conditionally Compatible	Conditionally Compatible	Conditionally Compatible	Partially Compatible	Partially Compatible	Partially Compatible
Containers (44,000 lbs)	288 x 96 x 96	Conditionally Compatible	Conditionally Compatible	Conditionally Compatible	Partially Compatible	Partially Compatible	Partially Compatible
Containers (60,000 lbs)	420 x 96 x 96	Conditionally Compatible	Conditionally Compatible	Conditionally Compatible	Not Compatible	Not Compatible	Conditionally Compatible
Containers (60,000 lbs)	480 x 96 x 96	Conditionally Compatible	Conditionally Compatible	Conditionally Compatible	Not Compatible	Not Compatible	Conditionally Compatible

LEGEND:

Partially Compatible: Unit load is compatible with some cargo spaces and handling equipment. See note.

Potentially Compatible: Unit load can be made compatible with some cargo spaces by increasing capacity of portable handling equipment and/or accomplishing relatively minor ship alterations.

Conditionally Compatible: Unit loads can be transported in space normally used for vehicles, landing craft or helicopters.

Compatible: Unit load is compatible with all cargo stowage spaces and handling equipment.

Not Compatible due to hatch size.

Note: Internal shipboard handling is weight limited to loads of two standard pallets by capacities of fork lifts and pallet trucks (4,000/6,000 lbs). Vertical conveyors in LPDs are size limited to single standard pallet loads. LPAs and LKAs can stow overweight or oversize loads in hatch squares.

FIGURE 5.3

SHIP-CARGO PACKAGE COMPATIBILITY

3. Loading Techniques

a. The degree of selective offloading capability depends upon the degree of cargo accessibility. The previous pargraphs have pointed out that cargo accessibility is a function of both ship configuration and cargo packaging. The particular technique employed in loading the ship is a third determinant of cargo accessibility. Using combat loading techniques, the standard method under current concepts, cargo becomes accessible serially, as unloading progresses downward through the various levels. It is only after a large share of the cargo has been unloaded that anything approaching random accessibility becomes possible. If, however, the ship is loaded initially by a method which specifically envisions selective unloading, a major share of the cargo becomes accessible much earlier in the offloading sequence.

b. Ship loading is essentially an operational matter, and is therefore outside the scope of this report. However, it is useful to examine a highly simplified comparison which illustrates the wide difference in accessibility between two loading techniques. Table 5.1 shows figures tracing the unloading sequence in an LKA-113 Class ship, giving comparative cargo accessibility at the various levels of unloading. In the table segment addressing general unloading, figures were developed based on conventional combat loading techniques. It may be noted that about 75% of the total cargo must be offloaded before all the remaining cargo becomes accessible for selective offloading.

Ship Status	Estimated Elapsed Time, Minutes	Conventional Combat Loading					Loaded for Selective Supply Support				
		Accessible (Thou. sq ft)		Total Load 1/ 58.2	Percent Cargo Accessible	Percent Cargo Offloaded	Accessible (Thou. sq ft)		Total Load 1/ 55.6	Percent Cargo Accessible	Percent Cargo Offloaded
		Vehicles	General Cargo 2/	% Total Accessible			Vehicles	General Cargo 2/	% Total Accessible		
Fully loaded Hatches secured.		0 0	2.7 3/	2.7	5	0	0.6 3/	18 3 3/	18.9	34	0
Hatches 2 4 open. Main Deck.		1 6 4/	2 7	4.3	7	0	2.2 4/	18.3	20.5	37	0
Boats off. Mn. Dk. hatches open.	0	3.9 5/	2.7	6 6	11	0	4.5 5/	18 3	22.8	41	0
Half hatch sq clear. 2nd Dk.	+ 12	14.3 6/	5.5 6/	19.8	34	3	14.6 6/	18 8 6/	33.4	60	3
Half hatches open. 2nd Dk.	+ 14						16 5 7/	18.8	35.3	63	3
Half hatch sq clear. 1st Plat.	+ 26						27 8 8/	19.4 8/	47.2	85	6
Half hatches open. 1st Plat.	+ 28						28.8 9/	19.4 9/	48.2	86	6
Half hatch sq clear. 2nd Plat., Holds 1 and 2.	+ 40						33.2 10/	19.9 10/	53.1	95	6
Half hatch open. 2nd Plat., Hold 2.	+ 42						33.7 11/	19.9	53 6	96	8
Half hatch sq clear. LH No. 2.	+ 54						35.3 12/	20 5 12/	55.6	100	9
2nd Dk. No. 2 4 unloaded. 13/	+ 118	20.4	6.9	27.3	47	14					
2nd Dk. No. 1 unloaded.	+ 124	23.3	7.6	30.9	53	21					
2nd Dk No. 3 unloaded.	+ 148	27.8	8.3	36 1	62	29					
1st Plat. No. 4 unloaded.	+ 231	27.8	11 2	39 0	67	35					
1st Plat. No. 2 unloaded.	+ 234	30.7	11.9	42.6	73	41					
1st Plat No. 1 unloaded.	+ 242	33.3	12.6	45.9	79	47					
1st Plat No 3 unloaded	+ 292	33.3	16.6	49.9	86	57					
2nd Plat. No 1 unloaded.	+ 348	33.3	19 3	52.6	90	62					
2nd Plat. No. 2 unloaded	+ 349	35.3	20.0	55 3	95	69					
2nd Plat No 3 unloaded	+ 597	35 3	22.9	58.2	100	75					

1/ Note that approximately 2400 sq ft less cargo is loaded in the selective supply support load. Approximately 150 sq ft has been reserved at each elevator access in the cargo holds. This 2400 sq ft represents the basic cost of increased selectivity in offloading.

2/ For convenience, square feet, instead of the conventional cubic feet, are used here for measurement of general cargo space. A stack of 2 pallets is given 20 sq ft

3/ Spaces are accessible via elevator or inclined ladder. The large elevators serving No. 4 Hold can provide access to several small vehicles.

4/ Vehicles stowed in the hatch square areas, Second Deck, of Holds 2 and 4 can be accessible without disturbing landing craft stowage.

5/ All vehicles stowed in the hatch square areas on the Second Deck can be accessible when landing craft are offloaded.

6/ Offloading one-half of the Second Deck hatch squares facilitates access to the remaining vehicles and general cargo in the Second Deck.

7/ Opening one-half of each Second Deck hatch facilitates access to vehicles stowed under these hatches on the First Platform.

8/ Offloading one-half of each First Platform hatch square facilitates access to the remaining vehicles and general cargo in the First Platform.

9/ Opening one-half of each First Platform hatch facilitates access to vehicles or general cargo stowed under these hatches on the Second Platform. When loaded for selective supply support, no additional general cargo would be made accessible by this action.

10/ Offloading one-half of the Second Platform hatch squares in Holds 1 and 2 facilitates access to the remaining vehicles and general cargo in these two spaces.

11/ Opening one-half of the Second Platform hatch in Hold 2 facilitates access to vehicles stowed under this hatch in the Lower Hold

12/ Offloading approximately 500 sq ft of vehicles from Lower Hold No. 2 facilitates access to the remaining vehicles and general cargo in this space.

13/ For convenience in the remainder of this sequence, each space is assumed to be accessible when the space has been unloaded and the hatch opened.

TABLE 5.1

CARGO ACCESSIBILITY (LKA-113)

In the second case, only about 9% of the total cargo must be offloaded to raise the accessibility level to 100%. Expressed another way, in the conventional combat loading case, about 75% of the cargo must be removed from the ship in order to have selective accessibility to the remaining 25%. In the ship specifically loaded for selective supply support, only about 9% of the cargo must be removed from the ship in order to have selective accessibility to the remaining 91%. It may also be noted from the table, however, that it is necessary to pay a price of about 2,400 square feet in cargo embarked to buy the improved selectivity. This loss originates from about 150 square feet that must be left open near each elevator access.

c. The figures displayed in Table 5.1 are oversimplified for illustrative purposes. Actually, there is an infinite number of ways in which a ship might be loaded, any one of which represents a slightly different selective offloading situation. The purpose of the table is to demonstrate the extreme sensitivity of cargo accessibility to the particular loading technique employed.

E. Cargo Information Flow

The flow of cargo information in individual ships must pull together the various cargo handling capabilities of the ship, and mesh these with the cargo information at the task force level, to integrate the ship's cargo management system into the overall amphibious cargo system. Integration with the total amphibious

cargo system is accomplished through the Ship's Logistic Control Center and its direct working relationship with the Logistic Support Center. Within the ship, the information system must perform on two dimensions: (a) it must document the operation of the ship's cargo system to ensure that reports, records and inventories are timely and accurate, and (b) it must facilitate control of the physical movement of cargo in a rational and responsive fashion. These functions are discussed in more detail below.

1. Record-keeping.

a. The record-keeping function is substantially different in selective unloading from that carried out under current concepts. Now, loading documentation, describing general location of cargo in the ship, is an essentially inactive data base after embarkation. Little, if any shifting of cargo in transit is feasible, and after arrival at the objective area, cargo is offloaded largely as it is uncovered in the ship. The detailed documentation is of interest to landing force units which are obliged to locate specific items after the cargo has reached the beach; but aside from routing major blocks of cargo to particular boat waves or sets of helicopter serials, the individual ship has no real need for a cargo data base to provide detailed information on a quick response, high-volume basis. Selective unloading, on the other hand, makes a cargo data base of vital interest to the individual ship.

b. The data base upon which a ship's selective unloading system operates must comprise a detailed list of all the amphibious cargo embarked. This must be catalogued to allow the SLCC to receive a request from the LSC, query the data base as to location in the ship, and to convey the order to the appropriate hold crew to initiate the process of assembling the requested cargo. An efficient system of assigning specific addresses to items of cargo plays an important role in these functions as does an efficient item description technique which is sufficiently brief to be manageable and yet sufficiently detailed to be reliably descriptive. The data base should be capable of reporting relative cargo accessibility in situations where the desired item or commodity is available from several different locations in the ship. And, as cargo is issued, or replenishment operations take place, the data base should be continually updated with new inventory postings.

2. Control of Cargo Movement

a. Besides maintaining accurate and timely records the cargo information system must also provide the means for directing and controlling the physical flow of cargo in the ship. This process involves communication of clear, accurate, intelligible instructions to the personnel or devices which must physically locate the desired cargo item within the ship. Appropriate instructions must be transmitted to other stations along the projected path of the cargo load, the cargo must be tracked

as it moves through the handling process, and it must be possible to alter the flow according to new instructions, or higher priority tasks, and to identify the specific transfer vehicles which were actually dispatched with the cargo load.

b. In carrying out the cargo movement control function, messages must be detailed, accurate and easily understood. A mistake made in this phase might mean a mistake in filling an urgent request from a combat unit in contact with the enemy. Delivery of the wrong caliber ammunition, or a similar error could have grave implications. Demands, therefore, on the quality and timeliness of the communication of instructions are stringent. Even in their simplest form, requests for cargo will likely be complex, since they will probably contain in a typical case, instructions regarding requesting unit, the class or type supply, the quantity desired, a combat priority, and possible special handling characteristics. The SLCC would probably add such elements as commodity location in the ship, its accessibility category, and other special notation. The LSC might add information regarding acceptable substitutes, or special action to be taken in case the desired item is not available.

c. It might be expected that regular dialog would be necessary between SLCC, hold crews, staging crews and debark crews after requests are passed initially. As individual loads for a specific unit might consist of cargo extracted from several different locations in the ship, and various loads might have special instructions as to packaging and transfer vehicle it is easy to

visualize a complex flow pattern of commodities between stowage points in the holds and debark stations where loads are awaiting lift ashore. There appears little doubt, therefore, that easy and reliable information flow between functional agencies would be vital to effective system performance.

d. The complexity of the cargo information requirement invites immediate attention to information management systems that are more capable than manual-voice systems. A key element in the operation of a selective unloading system operating in the retail supply mode is the management of the information upon which the system operates. Because of the importance of this element, the subject of information management is treated in more detail in the chapter that follows.

VI. DATA PROCESSING CONSIDERATIONS IN A SELECTIVE UNLOADING ENVIRONMENT

601. GENERAL

The preceding sections of the report have addressed some of the requirements for physical materials handling and information management which are necessary to support selective unloading of amphibious ships in modern amphibious operations. It is readily apparent upon examining the magnitude and stringency of the demands imposed by high-volume selective unloading, that manual information handling techniques would severely limit the effectiveness of the system, and that more advanced, automatic data processing techniques are the means to realize the full potential of selective unloading. This section deals briefly with these data processing considerations. The scope of the material presented here does not allow discussion of the important distinction between a computer based management information system to provide decision-makers with information, and the information system by which these decisions are conveyed to lower echelons and the command loop is closed. In the sections below, only the general information system functions are discussed, followed by descriptions of several alternative system configurations.

602. INFORMATION SYSTEM FUNCTIONS

A computerized information system for management of selective unloading must perform a variety of operations. These can be divided generally into four primary software areas: information collection, inventory control, communications and retrieval and auxiliary operations. Each is discussed in more detail below.

A. Information Collection

The information collection portion of the system must maintain and allow access to data in the logistic planning base. This will provide information concerning availability, movement, and location of ships and supplies. The software associated with the information collection subsystem will be of several types. First, there are the data files, which contain the actual information collected, and may be located on magnetic tape or disc storage units. Next, are the programs necessary to report information from these data files. This output software will be designed to print desired selections of information or the total data file. Third, is maintenance software which provides for changes to the existing information of file, additions to the files, and deletion of obsolete information. The information collection subsystem would be used primarily in the planning and early stages of an operation, providing background information for the planning of the desired assault.

B. Inventory Control

An inventory control system maintains information concerning cargo loaded for an operation. First, this system records information as cargo is loaded and produces a disc or tape inventory file.

This includes a description of what has been loaded, where it is located, how much is at each location, and other information normally contained in MEDS (Mechanized Embarkation Data System) cards. A second part of inventory control software is a report generator. This provides for real time lists of inventory as cargo is loaded, final cargo listings upon completion of loading, and periodic updated listings throughout the operation. Update programs will change inventory counts, locations, and other affected information as cargo is shifted within a ship, among ships, or from ship to shore. Finally, the inventory control subsystem provides the user with capability to ask for information on particular cargo items. A query may be made from any of several locations; the desired information is extracted from the updated inventory file and is used as output at the requesting terminal site. The inventory control subsystem is required from the loading phase of a mission to its completion. Further, the final inventory files may provide important information concerning most and least used items, stock levels for future operations, and most effective locations for various cargo.

C. Communications and Retrieval

1. The most complex portion of the total Information System will be the communications and retrieval subsystem. This processes logistic requests, assists in determining possible means for filling the request, communicates the request to appropriate levels and monitors and records the sequence of events from request to delivery. An important part of this subsystem is the communications network. This would provide for interaction between shore and ships, among ships, and between the SLCC and other areas of an individual ship.

At the shore to ship level the network must handle multiple simultaneous requests and direct them to the receiving data processing center. Between LSC and SLCC communications will be expected to monitor status of requests, to provide complete computer capability to the SLCC with access to files and programs located only at the LSC, and to update inventory files at the LSC. Communication within an individual ship will allow direction of crew members in locating cargo and moving cargo to selected staging areas. Further, it will relay transportation information to affected areas and receive status information on the progress of requests.

2. Data retrieval software includes the data files containing required cargo information. In most cases these will actually be the inventory files and will be shared by the inventory control subsystem. The routines which operate upon the data files should be capable of searching the inventory and finding information on all alternatives for filling a request. In turn, the alternatives will be examined and the request transmitted to an appropriate SLCC.

3. Monitoring of requests is another function of the communications and retrieval subsystem. As a request is received it will be recorded, identified by number or code, and given a status number. As the request progresses toward completion the status is continually updated by the appropriate SLCC. It is the task of the system to update the status, to report the current status whenever it is requested, and to keep a complete backlog of all requests and their current and closing status.

4. The communications retrieval subsystem will be used primarily in the assault and resupply phases of the operation. However, the capability can be in constant use for monitoring and answering requests throughout the operation.

D. Auxiliary Routines

1. To enhance the capability of the entire Information System, a number of auxiliary routines would be available. Included are optimization programs capable of determining most probable solutions to requests for cargo, personnel, transportation, and other services. These solutions can be used as decision-assist tools. Other programs may include statistical routines, special peripheral (printing) routines and "housekeeping" or accounting routines to assist in file maintenance. These auxiliary programs will be of general use to both LSC and SLCC operation throughout the mission.

2. It is apparent upon defining and describing these elements of an information system that all are highly integrated. Many of the tasks overlap, thus the systems to handle them also intersect. In many cases systems or programs will be general enough to be of multiple use. Further, since different activities will occur simultaneously, multiply, and will recur, the meshing of the entire system is of extreme importance.

603. SYSTEM CONFIGURATION ALTERNATIVES

A large number of hardware-software configurations may be postulated to provide the services to be performed by the Information System. However, there appear to be three major categories for description of these data processing units: 1) manually oriented systems, 2) completely computerized systems, and 3) varied levels of automation.

A. Manually Oriented Systems

1. A manually oriented system corresponds to current cargo management techniques supplemented with automation for bookkeeping purposes only. Necessary hardware includes a card reader and a printer to read and list initial inventory cards, plus a magnetic tape or disc storage unit to maintain this inventory on a file. Software requirements are minimal. A program is needed to produce the list of inventory cards, the final inventory of cargo, and to print updated cargo inventories. Throughout the operation the existing file would be altered as cargo is delivered from ships to the using units ashore. A simple mathematical routine would handle the addition and subtraction of items to update the inventory file. Other activities involved in cargo management would be handled manually. As requests are made, cargo lists would be checked to locate items and the appropriate SLCC and transportation units would be notified. All communication would be over voice radio or by internal ship systems. Manual updates to inventory listings other than count changes would be necessary.

2. Some of the disadvantages in this system are obvious. The sheer bulk of paper work and dependence upon physical files is a detriment. Difficulties in managing, by hand, many simultaneous shore to ship requests is evident, to say nothing of the difficulty in manual locating, handling, and delivery of services. Communication of detailed cargo descriptions between ships is slow and inefficient using only voice radio. However, even in this manually oriented configuration there is enough machine processing to relieve the most tedious tasks of typing, re-typing and updating the inventory by hand.

B. Completely Computerized Systems

1. Total automation implies a large and complete data processing center in the LSC and each SLCC. Software requirements for such a complex include inventory files, transport files, and inventory control programs to manipulate these files. Further, a large communications retrieval system would be necessary to handle multiple requests, determine the appropriate SLCC to fill each request, and to update the appropriate data files. Auxiliary routines to aid in the system operation must also be available. To support such software systems at each processing center a complex hardware configuration is needed. Peripheral equipment (card reader, printer, tape or disc units) is needed to produce and maintain the cargo inventory file. This file will be in great detail, containing not only amounts, but specific locations, unit of pack, unit of issue, and other cargo characteristics. At this level of automation files concerning transportation vehicles and schedules, troop movement and location will exist. Since the scope is far greater than for the manual system, a proportional increase in equipment is expected.

2. To operate upon the files automatically requires large disc storage units for the software and for the processing; a large bank of core is needed for maintenance of the files, as well as to handle the communications and retrieval system. Communications equipment capable of handling interaction at all levels is necessary. An automatic communication system between ship and shore, between ships, and within an individual ship is necessary. As a request is received by the LSC data processing center, the request will be printed out and acceptance or rejection of the request will be manually entered on a communication device.

Once a request is accepted, decision-assist information is communicated to the LSC automatically. Transmission of the request is then made automatically to the selected SLCC. The same chain of events would occur at the SLCC for acceptance. On this level, however, information concerning detailed location of items requested would be given. The necessary shipboard personnel would be notified, and communication maintained between the SLCC and affected ship areas until a request is filled. Once a request is filled this status would be handled automatically by the data processing unit. Little manual intervention should be required, and that which is necessary consists primarily of choices in decision making situations and acceptance or rejection of proposed alternatives.

3. Several remote access terminals would be desirable. At certain levels a terminal with high speed printing may be required. For other areas cathode ray tube display units would be most useful, while in still others teletype terminals would be adequate. With a system as automated as the one described remote devices should be located in all areas where communication is desirable. This allows greater flexibility in interaction aboard ship.

4. With a data processing center as described aboard each ship, advantages can be readily pointed out. Little tedious. time-consuming paper manipulation would be necessary. Information would be instantaneously available to aid in decisions, to provide cargo lists and to provide historical information of all kinds. Communication would be rapid and efficient. Personnel once required for clerical assistance may be relieved for other vital duties. Each ship maintains independent records, thus allowing constant checks to insure up to date file maintenance. Perhaps most important would be the ability to handle many

simultaneous requests with speed and accuracy, thus improving the chance of success for the entire assault operation.

5. The drawbacks of total automation must also be mentioned. Installation of a large computer center in each ship may require considerable ship alteration. Highly trained personnel to operate each processing center are essential, as well as technicians to insure maintenance of the hardware involved. Finally, to produce hardware and software for the proposed system is expensive and time-consuming.

C. Varied Levels of Automation

The two previous descriptions represent rather extreme system configurations. Three less extreme configurations are described below.

1. Automation concentrated at the LSC

a. This provides for a large central data processing unit located within the LSC. Each SLCC would be provided with remote communications devices for interaction with the LSC. Software for the LSC will be as described for a totally computerized system including all inventory and data files, inventory control programs, a communications retrieval system, and auxiliary routines. In addition, retrieval software would be expanded to include routines for locating cargo on any ship, and for assisting in internal shipboard activity.

b. The communications network would have broader responsibilities. As described, all requests would be sent to this center.

Operation upon the request remains the same until an SLCC is selected to fill the demand. Transmission of the request would be accompanied by cargo location information. Arrangements for transportation would stem from the LSC. Monitoring of requests at all stages and status updates would also lie with the central processing unit. Once a request has been filled, all file updating and management would be handled at the central level.

c. Hardware to support the central processing area would be as described for the completely automated system. Additional and in some cases more complex, remote devices would be needed. At the SLCC level the remote terminal should provide high speed print capability to insure hard copy of files as needed. Other levels might require a variety of terminals: picture display, teletype and hard copy machines.

d. The computerization provides relief from the physical handling of inventory files. Reductions in the amount of hardware offers other advantages such as fewer ship alterations, fewer computer specialists and less expense. Concentration of files and their maintenance at one site provides uniform record keeping and insures that master files are properly maintained. This central concentration may also be detrimental. For a single center to be responsible for all communication and interaction places a very heavy burden on both equipment and personnel. A break in communications between an SLCC and LSC would revert the SLCC to a totally manual system. Further, no backup of software or files is provided to the LSC. Though there appears to be savings in equipment, the software required to handle the entire operation might require unreasonable amounts and types of supporting hardware.

2. Independent SLCC centers

a. This system provides for a data processing unit aboard each ship; however, the configurations differ from those described previously. As before, the LSC would handle incoming requests, but would maintain only an undetailed Master Amphibious Inventory (MAI) and transport data files. (The undetailed MAI lists only broad cargo characteristics such as what, what ship, and how much.) Inventory control and retrieval software is as previously described. Auxiliary routines would also be maintained at this single location. Upon completion of delivery the LSC would be informed and the master files updated. Equipment for the LSC will be as described in Section B. However, fewer storage units are required because fewer and less complex files would be handled, and core may be decreased since responsibility for much of the activity would fall to the SLCC. Peripheral equipment such as printers, reader, terminals would be required as before.

b. At the SLCC level each data center would maintain a Ship's Amphibious Inventory (SAI), and inventory control routines to manipulate it. A communications and retrieval subsystem would be capable of retrieving cargo locations. While the request remains at the SLCC, status updating and monitoring would be performed there. Hardware for the SLCC center should consist of tape and/or disc storage units for file handling, a moderate core bank to allow inventory updating and retrieval operations and a high speed print capability. Remote terminals should be located at strategic areas to allow communication with various cargo sites.

c. As in the previous systems, the advantages of computers in the administration of cargo management are apparent. Further advantage lies in the ability of the SLCC to act independently, relieving much of the pressure placed on the LSC and the communications network. Each ship needs its own inventory file, while general purpose items such as the auxiliary routines would be at the LSC for all to access. Since responsibility for a request would be transferred with the request, the LSC would be freer to handle incoming demands more effectively.

d. Disadvantages include the large amount of equipment required. Ship alterations may be necessary to accommodate even moderate processing centers, along with technicians to maintain the systems. With individual data centers there is also the risk that master files would be improperly updated. Responsibility must be carefully delegated to avoid a breakdown in the integration of the entire system.

3. Combination System

a. Realizing that needs for cargo management and handling vary among ships in an amphibious task force, a system to consider these individual characteristics is postulated. This system revolves around a central data processing unit located in the LSC. On those ships carrying limited quantities of cargo, only remote communications terminals would be available. Aboard ships with varied and/or large quantities of cargo a moderate computer center as described in the previous section would be employed.

b. Hardware and software requirements for the LSC would be similar to those for the case of independent SLCC centers.

In addition the LSC would maintain detailed ships inventory files for those ships having only remote terminals. Equipment requirements at the SLCC would correspond to those described in either earlier case (automation at LSC or independent SLCC center) depending upon cargo. The systems would function as described previously.

c. This system attempts to make most efficient use of equipment, software, and personnel in accord with requirements. Certain SLCC's may operate independently, yet still rely on the LSC as back up; while other SLCC's are dependent upon the LSC, but are not burdened with unnecessary activities. Disadvantages exist in that a communications break at certain levels might result in manual operation, particularly where only terminals are available. Also, this system could limit shifting of cargo among ships since all are not equally equipped to handle varied cargos. Determination of need of automation presents a practical problem and must be thoroughly investigated.

604. EXISTING AND PROGRAMMED AMPHIBIOUS SHIP COMPUTERS

LPH Class ships, now operating in the Fleets, have the U-1500 general purpose computer systems installed, which are used primarily to assist in management of the ships' supply systems. The new command ships, the LCC-19 Class, each have four USQ-20 computer systems. In each LCC-19 Class ship, three of the four are used to support tactical data systems; the fourth is equipped with disk storage units for use with the special purpose program, QUEST, which is designed to support targetting and logistics functions. The LHA Class, none of which is yet commissioned, will have UYK-7 computer systems to be used in support of tactical data systems and the Amphibious Support Information Systems (ASIS). The use of these computers as part of one of the Information

Systems discussed in this report would depend on the final system configuration chosen. In LCC-19 Class and LHA ships, some computer capacity is devoted to amphibious logistic support, while in the LPH the installed computer equipment is primarily devoted to other tasks. Until the information system characteristics are further defined, the specific usefulness of any of these machines cannot be assessed.

APPENDIX A
DEVELOPMENT OF A FRAMEWORK FOR ANALYSIS

A.1 GENERAL

A. To support the discussion in the body of this report it was necessary to establish a context in which to examine future cargo management functions. This section defines such a context by developing a logical arrangement of processes and functions. based principally on original work and partly on work done by the SMLS Study Group and other operational groups studying seabased logistic problems. This arrangement served as a framework for analysis in this report.

B. The Naval Amphibious Logistic System (PHIBLOGS) described on the following pages is a hypothetical system. designed by Presearch and keyed to work performed by the SMLS Study Group and other operational groups. which integrates the varied support tasks into a single logistic system. The system description. which establishes the framework for analysis. first addresses the characteristics of the total system tailored to the new environment. next the subsystems to control logistics in the assault, and finally a component subsystem for management of a single ship's cargo in support of the assault. PHIBLOGS. therefore. furnishes a basis for examining individual problems and system components

as elements of a total coherent logistic structure defined in three layers of detail. This section of the report addresses the first layer: the total amphibious logistic system.

A.2 THE NAVAL AMPHIBIOUS LOGISTIC SYSTEM (PHIBLOGS)

A. PHIBLOGS is a hypothetical material handling and control system which integrates the varied logistic support tasks into a single coherent structure. PHIBLOGS is not tied to a specific hardware array; however, the system and subsystem descriptions that follow generally presuppose a minimum basic automatic data processing capability for data storage and retrieval, inventory control, and simple mathematical processing.

B. The PHIBLOGS concept spans the period from receipt of the initiating directive prior to embarkation to completion of the amphibious operation and preparation for subsequent operations. The system is designed to optimize logistic support directly from a seabase to using units ashore. However, the system does not necessarily demand exclusive use of seabased logistics; rather, it allows the specific amount of seabased support which best fits the needs of any particular operational situation. The PHIBLOGS system is comprised of three major subsystems. These subsystems, shown in Figure A.1, include:

1. Loading Control Subsystem (LOADLOGS)
2. Underway Logistic Control Subsystem (UNLOGS), and
3. Amphibious Landing Logistic Control Subsystem (LANDLOGS).

	PHIBLOGS (Naval Amphibious Logistic System)		
Key Logistic Functions	**LOADLOGS** (Loading Control Subsystem)	**UNLOGS** (Underway Logistic Control Subsystem)	**LANDLOGS** (Amphib. Landing Logistic Control Subsystem)
Cargo Management	Physical Handling Cargo Information Flow		
Maintenance			
Transportation			
Medical			
Service Support			

FIGURE A.1

THE NAVAL AMPHIBIOUS LOGISTIC SYSTEM

C. The first subsystem, LOADLOGS, functions in the planning and embarkation phases. It furnishes support in the form of background and historical data upon which to base logistic estimates and plans; it assists in preparation of loading plans and documentation; it provides management information system reporting to the various interested agencies during the loading process, and it formulates the Master Amphibious Inventory.

D. The second subsystem, UNLOGS, has its principal value in providing a means to adjust, shift, transfer or otherwise manipulate cargo or other logistic resources among ships while in transit to the amphibious objective area. Although it is technically a separate subsystem, UNLOGS employs the resources of the LANDLOGS subsystem.

E. The third subsystem, LANDLOGS, provides a number of essential services in the amphibious objective area. It dispatches and routes logistic vehicles in the ship-to-shore movement and in resupply. It maintains running inventories of supplies on hand ready for distribution and maintains desired inventory levels. It provides data processing assistance to the commander in managing the overall logistic operation. LANDLOGS encompasses all those special techniques and hardware needed to perform the seabased logistic jobs in the assault.

A.3 THE LOADING CONTROL SUBSYSTEM (LOADLOGS)

A. The concept of LOADLOGS includes the conventionally established processes in amphibious embarkation, with the addition of those special features needed to prepare the Amphibious Task Force for later seabased logistic support of the assault. The following describes the functional agencies that make up the LOADLOGS structure, and the operation of this subsystem.

B. Functional Agencies of LOADLOGS

LOADLOGS operates through six functional agencies, whose activities vary as planning embarkation and loading progress toward the transit phase. These agencies are:

1. The planning and logistic staffs of the Fleet.

These groups, in their normal conduct of business, maintain up-to-date libraries of contingency plans, logistic estimates and fleet capabilities. Further, they monitor the general supply posture of the various stock points which might be called upon to support future amphibious operations. These regular staff functions form the base from which the LOADLOGS processes are developed after receipt of the initiating directive.

2. Embarkation and Loading Control Center (ELCC).

This facility, activated upon receipt of the initiating directive, is manned by representatives of the Amphibious Task Force and Landing Force Staffs. It operates as a shorebased activity initially, but may be shifted later to the flagship, should the particular situation so indicate. The ELCC is the principal agency which coordinates the embarkation and loading activities of ships of the Task Force, the embarking units, the staffs of both the Amphibious Task Force and Landing Force, and any other agencies involved in the processes of embarkation and loading. The scope of this facility is broader than that of the Embarkation Control Office, discussed below. The ELCC staff ensures that ships' individual loading plans and the overall loading scheme within the Amphibious Task Force are compatible with later seabased logistic support in the assault. A principal role of the ELCC is development of the Master Amphibious Inventory, which will become the key management tool for the total cargo control process throughout the operation. This is described in detail later in the section which outlines the operation of the LOADLOGS subsystem.

3. Embarkation Control Office (ECO).

This is the facility envisioned in conventional amphibious embarkation concepts which coordinates the actual embarkation of troops and cargo. It operates under the coordination of the ELCC, and may be co-located with it if the local situation permits. In any case, however, the ECO retains its conventional

responsibilities and functions, but in addition serves as an arm of the ELCC in ensuring an orderly execution of such specialized steps as may be needed for a mobile seabase support operation.

4. Logistic Support Center (LSC).

Although this agency plays no essential role in LOADLOGS, it must be activated and operational in the latter stages of LOADLOGS to ensure an orderly turnover of documentation and functions from the ELCC to the LSC upon departure of the Amphibious Task Force from the ports of embarkation. Ideally, this turnover takes place during the latter stages of the embarkation phase, after the LSC is established and ready to assume the ELCC function, and when directed by the Amphibious Task Force Commander. However, if the geographical locations of the ships of the Amphibious Task Force do not facilitate such an overlap, the turnover may be delayed until the embarkation is completed and the Task Force departs for the objective area.

5. Logistic Support Center (Rear) [LSC (Rear)].

This facility is activated when the amphibious sequence shifts from the embarkation to transit phase. Its purpose is to serve as the rear arm of the LSC. It acts in a liaison role, and has the effect of furnishing the Amphibious Task Force Commander with a staff representative remote from the amphibious objective area, but more conveniently located for coodinating and

expediting logistic flow to the Amphibious Task Force, and providing rear area assistance in solving logistic problems that extend outside the amphibious objective area.

6. Ships' Logistic Control Centers (SLCC)

Each ship allocated for a logistic role in the mobile seabase establishes a logistic agency, whose purpose is to coordinate the logistic activities of that ship. In the embarkation phase its function is essentially that of the Ship's Combat Cargo Officer in the conventional role. As the operation progresses, however, and as the mobile seabase assumes direct logistic support of the Landing Force, the SLCC becomes a key element in the organization for logistic support.

C. LOADLOGS Operation

The operation of the LOADLOGS subsystem passes through three basic modes. These are the "STANDBY MODE", when certain files, records and plans are maintained in a condition of currency; the "EMBARKATION MODE," upon receipt of the initiating directive, when the loading and embarkation process is actually carried out, and the "BACKUP MODE," upon completion of embarkation, when rear area coordination of the logistic operation takes place. This sequences of operations is shown in Figure A. 2, and described in the following paragraphs.

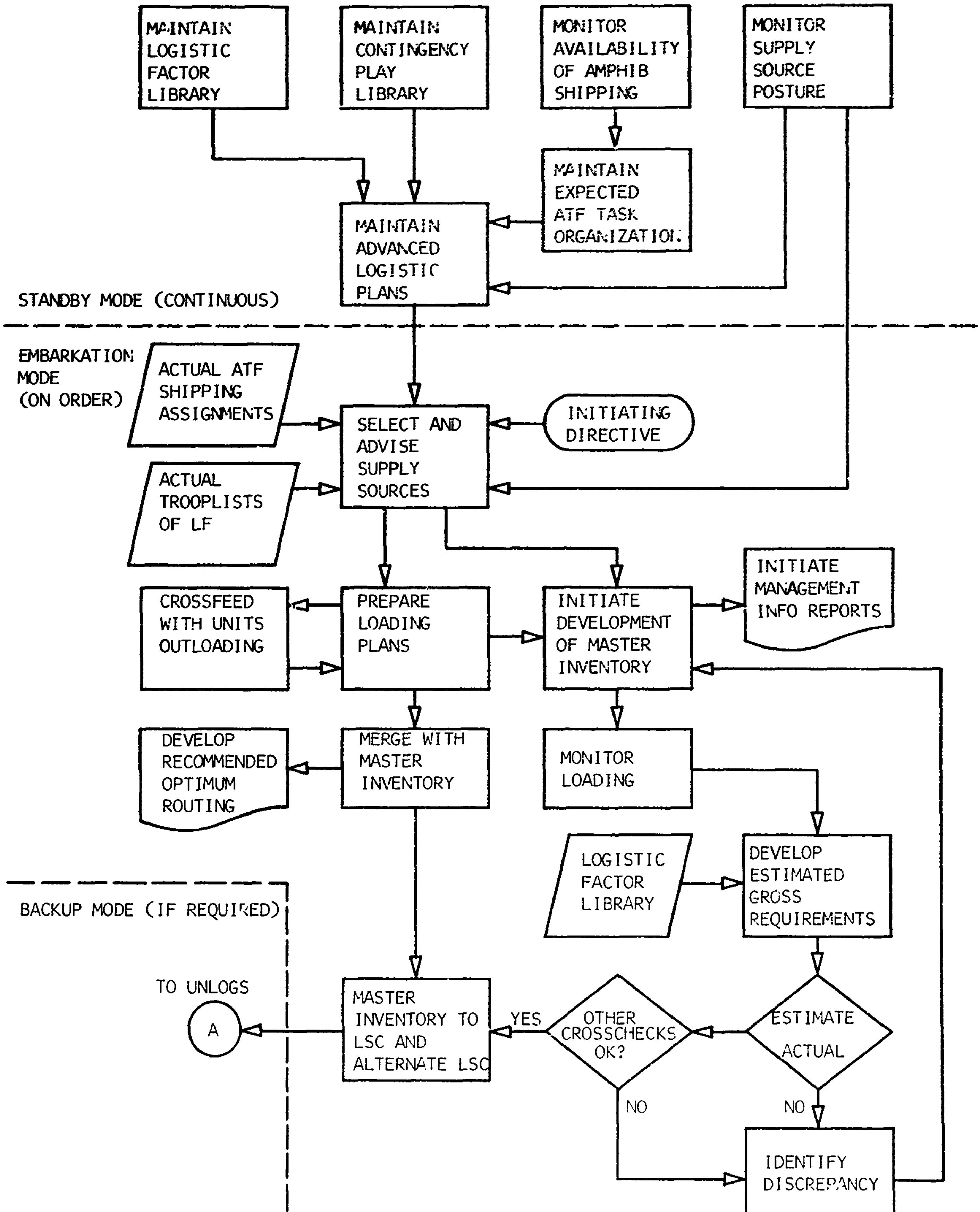

FIGURE A.2

LOADING CONTROL SUBSYSTEM (LOADLOGS) FUNCTIONAL DIAGRAM

1. STANDBY MODE

a. The STANDBY MODE identifies that level of system operation where the normal planning and logistic staffs of the Fleet and Unified Command, in the routine conduct of their regular duties, generate the data base upon which a specialized amphibious logistic structure can be formulated when needed. No specific functional agencies are activated to carry out LOADLOGS in the STANDBY MODE.

b. On a continuous and routine basis, Fleet Staff sections may maintain a logistic planning base which facilitates rapid and orderly response to initiating directives and subsequent operation plans and orders. This regular staff action also can furnish a ready library of information to support logistic feasibility studies in relation to possible future operations. The principal value of these steps to LOADLOGS is to continuously maintain a source of logistic planning information in an advanced state of development for amphibious planners. This data base may contain a number of pretested alternatives, a bank of specific information developed on the basis of extensive research, answers to a number of key logistic questions that require considerable time and effort to derive, and, in general, can advance logistic plans substantially further along in the planning cycle almost immediately upon receipt of the initiating directive.

c. This advanced logistic planning base consists of four major elements:

(1) The Logistic Factor Library

The Factor Library contains such information as typical mountout and trooplist for various levels of seaborne logistic support. It contains square, cube, weight, or other numbers necessary to describe the needs of a variety of configurations of landing force task organizations. In addition, the library maintains a detailed listing of ships' characteristics, arrayed in a variety of task organizations which might be pertinent to different amphibious operation requirements. Included also in the Factor Library are approximate time-distance factors related to assembly, preparation and staging of cargo and supplies, plus closure times for a wide variety of task force compositions and possible objective areas. It is not necessary that this information be absolutely precise nor in the detail required for actual execution of an operation. Instead, the factors are kept in sufficient detail and currency to facilitate logistic feasibility assessments and other logistic estimates.

(2) The Contingency Plan Library

The Contingency Plan Library contains the key operational and logistic elements of all the contingency plans which the command is charged to support. The operational elements of plans are recorded in sufficient detail to provide a backdrop for logistic analysis, but the logistic requirements are recorded in the same level of detail as the original plans and may contain additional amplifying information.

(3) Status of Source Stocks

(a) This segment of the planning base consists of lists, coded for easy retrieval and periodic print-out, of the status of supply points scheduled to support the various contingency plans. This listing also includes time-distance factors and computer programs which facilitate immediate determination of best selection of source in cases where more than one source is available. The listing permits periodic screening to ensure that sources can, in fact, support the entire family of plans. In cases where sources cannot do this, provision is made to flag problem areas for alternative actions.

(b) The source stock listing also includes gross values which can be used to compute predicted drawdown on source stocks by contingency plans of other services, or plans not carried in the Contingency Plan Library. The aim of this function is to ensure that support for an operation is not keyed to sources which are also earmarked for a different operation, and would therefore be actually unavailable. This is particularly important for supply points which are scheduled to support several different military services.

(4) Amphibious Shipping Availability Listing

This listing contains by hull number and class all those ships which might reasonably be available for an

amphibious operation, along with the immediate operating schedule of each. These listings mesh with those of the Factor Library and subsystem interfacing allows cross retrieval of information. The Shipping Availability Listing can in this way readily produce tentative task organizations of ships to support a specific operation. These optimum shipping arrangements may be used as recommendations, for the Commander, prepared solely on the basis of logistic factors.

2. EMBARKATION MODE

a. LOADLOGS shifts into the EMBARKATION MODE upon receipt of the initiating directive. The Embarkation and Loading Coordination Center is activated at this time, points of contact on the various staffs are designated, and data from the STANDBY MODE is made available to staff points of contact. Actual shipping is designated and troop lists are prepared by appropriate commanders, who also determine the desired level of seabased logistic support. Troop, square and cube computations are developed, based on supply levels and selected level of seaborne logistic support. Primary supply sources are selected and liaison is established.

b. Once these fundamental steps have been taken, LOADLOGS operation begins to move along two parallel, closely related lines of effort. These are the preparation of the loading plans and documentation, and the development of a Master Amphibious Inventory.

(1) Preparation of Loading Plans and Documentation

Using documentation (such as the Marine Corps Mechanized Embarkation Data System) from the units to be embarked and input from STANDBY MODE files, detailed loading plans are developed. The process may be manual, fully automated employing advanced computer programming techniques, or hybrid, using some of each. To the extent that the detailed loading plans are developed by computer the focus of loading/planning effort will shift from the units to be embarked toward the ELCC, in contrast to fully manual loading/planning. This is not to say that the task can rest fully with either organization in either case; it means, rather, that the emphasis on the specific planning details will tend to shift the ELCC with increased automation and thus intensify the importance of close and effective liaison, as the ELCC relieves embarking units of much more of the workload associated with manual loading/planning.

(2) Development of the Master Amphibious Inventory

(a) The Master Amphibious Inventory is the principal end product of the total LOADLOCS process, and its development provides the central baseline of all documentation of the embarkation and loading phase.

(b) As early as possible in the process, all embarkation data are coded and introduced into the Master Amphibious Inventory data base. This data base becomes the core of the loading documentation process and the basis for the entire embarkation control and information processes throughout the LOADLOGS cycle.

(c) As material to be embarked begins to undergo identification, packaging, assembly, staging and actual loading aboard ship, postings are made to the data base to provide a continually changing, and current, listing of cargo, plus the specific status of each segment of the cargo. As individual items or packages are added or deleted from the lists of items to be loaded, the data base is appropriately updated. As a particular source is designated for a specific item, or quantity of a certain commodity, appropriate entries are made. Similarly, as the item passes through the system, it is tracked by LOADLOGS through reports to the ELCC.

(d) Since updated loading plans are being continuously fed into the data base, the LOADLOGS has what amounts to a detailed and specific overall objective. Ultimately, when an item is actually embarked, that step is noted and crosschecked against the embarkation data input. As discrepancies are noted, liaison with the embarking unit, transportation agency, or primary source allows identification of the error and correction. These steps constitute a feedback loop into the

Master Amphibious Inventory records. As the developing Master Amphibious Inventory shows items embarked and ready, and as these are verified and subtotaled against the overall objective, a progress measurement system appears which can provide status reports to interested agencies in considerable detail, and in a timely manner.

(e) By the time the actual loading reaches its final stages, each ship will have developed a detailed data base describing its own loading situation. This data base lists individual items of equipment, pallets, packages, or other elements carried as line items in unit cargo records. Each line item is identified in detail, including such information as the unit to which the item belongs; its supply class; specific location in the ship and accessibility status; combat priority; special handling characteristics, if any; expected usage factor; replacement or resupply time; directly related (family) items or substitutes, and any other special notation. The data format specifically allows convenient sort and retrieval according to any of the various item characteristics. Programs and systems allow printout or other output display to show, for example, the total tonnage of a certain class of supply embarked, total number of items of specific combat priority or total POL, broken down by type, quantity and ship in which embarked. Except for specific location within the individual ship, essentially the same information is entered in the Master Amphibious Inventory as in the individual ship inventories.

(f) EMBARKATION MODE operation is closed out when the embarkation and loading are complete and when the Master Amphibious Inventory reflects the actual loading posture of the Amphibious Task Force. By this time a variety of cross checks will have been made to insure that the Master Amphibious Inventory is not only an accurate representation of the material and personnel actually embarked in the ships of the ATF, it must also have verified this information against the aggregated embarkation data held by the embarked units. The Master Amphibious Inventory must, therefore, reflect the cargo and personnel that embarked units believe they have embarked. The EMBARKATION MODE cannot be closed out until this two-way cross check has been made: a check against material and personnel actually in the ships, and the material and personnel that embarking units believe they have loaded.

(g) Upon close-out of EMBARKATION MODE operation, copies (probably tapes) of the Master Amphibious Inventory are delivered to the Logistic Support Center (LSC) and to the one or more alternative LCS's that have been designated to assume logistic control in case of emergency. In addition, a copy of the inventory is held intact by the ELCC for possible future reference such as post-action reports, critiques, training uses, or other post-operation documentation. Finally, a copy is entered into the BACKUP MODE data base of the ELCC.

3. BACKUP MODE

The ELCC shifts in BACKUP MODE operation immediately upon completion of embarkation. When the Logistic Support Center assumes primary responsibility for maintaining the Master Amphibious Inventory and overall control of the logistic support operation, the ELCC then assumes its role of rear area support of the Amphibious Missions. This shift coincides with end of the embarkation phase and initiation of the transit phase.

A.4 THE UNDERWAY LOGISTIC CONTROL SUBSYSTEM (UNLOGS)

A. The UNLOGS subsystem allows manipulation of cargo among ships during transit to the objective area. Its principal value is in the added flexibility it accords the Commander in dealing with contingencies which occur after embarkation, but prior to the assault. For example, a ship with a mechanical casualty sufficiently serious to render it unable to continue, might shift some or all of its cargo to another ship, allowing the operation to proceed as originally intended. In other cases, key items of equipment or segments of cargo might be damaged or lost during the transit phase. These circumstances could be alleviated by underway replenishment by ships or aircraft from sources outside the Amphibious Task Force. Late changes to the amphibious mission or major realignment of the tactical situation might also be alleviated to a degree by the UNLOGS capability.

B. The functional agencies of UNLOGS are the Logistic Support Center and the Ship's Logistic Control Centers. Both can be easily manned and activated since all their personnel and facilities are already embarked in readiness for the assault. If it proves necessary to activate UNLOGS, the resulting manipulation of cargo is simply posted against the Master Amphibious Inventory and the revised inventory is held for the subsequent assault.

C. Another important possibility in UNLOGS is that of underway training in the transit phase. Assuming a relatively advanced automatic data processing capability in the flagship, and a Master Amphibious Inventory in the flagship's data base, special computer programs could readily allow command post type exercises in a wide variety of logistic support problems. The LSC, and several SLCC might be activated for training, with several FLCC simulated, but manned by regular landing force personnel. The entire logistic process might then be played in an almost infinite number of variations. Not only would it be possible to exercise the individuals who man the various functional agencies, it would also be possible to test the logistic impact of losses of specific ships, segments of cargo, logistic support aircraft or other logistic resources.

D. The resources needed to realize an underway logistic training capability are not extensive; the computer and communications demands are not extremely sophisticated, by current standards. Programs capable of providing realistic problem play,

however, require greater attention. Possibly, simulation models now being developed at several different activities might be expanded or adapted for this purpose. In case this does not prove feasible, specific programming effort might be necessary. In either situation, however, underway training of logistic personnel appears to represent an important possible contribution by UNLOGS.

E. UNLOGS is not of dominant importance to seabased logistic concepts. On the other hand it offers additional tactical flexibility and extremely valuable training opportunities at no expense in resources. All the elements of UNLOGS are present in the Task Force by virtue of its seabased logistic orientation. Thus, UNLOGS comes as a bonus which gives a measure of insurance against certain types of contingencies and provides a means for specialized training late in the amphibious sequence.

A.5 THE AMPHIBIOUS LANDING LOGISTIC SUBSYSTEM (LANDLOGS)

A. LANDLOGS encompasses the total logistic control function for the Commander, Amphibious Task Force, in the amphibious objective area. Through the Logistic Support Center, LANDLOGS receives and processes requests for logistic support. It maintains logistic records such as inventory levels in ships and reorders to maintain desired supply levels. LANDLOGS coordinates the actions of other agencies in logistic support matters and the employment of logistic support vehicles, including helicopters. It

provides detailed and timely information to the Commander regarding logistic posture, and it provides decision-assist recommendations on complex logistic matters requiring command decision. Thus, LANDLOGS is actually a complex of systems which, through its functional agencies, integrates the total amphibious logistic effort.

B. LANDLOGS is activated at the time of final shipboard preparations for the assault phase, and continues to function until the amphibious operation is completed and troops and material have been reembarked to carry out subsequent operations, resume a ready reserve posture, or accept other orders.

C. For reasons pointed out earlier, a decision might be made to place emphasis on a shorebased logistic structure, including the installation ashore of a primary logistic control facility. However, this presents no functional problem, since LANDLOGS is structured to allow individual system elements to be replaced by shorebased facilities, depending on the particular needs of the operation. In addition, the Commander may choose to alter the logistic support structure as the operation progresses, shifting portions of the resupply tasks, specific maintenance functions, or service support between seabased and shorebased sources.

A.6 TYPES OF SUPPORT TO USING UNITS

LANDLOGS furnishes five basic types of logistic support to using units. These are supply, maintenance, transporation,

medical and service support. Each of these is discussed in greater detail below.

A. Supply

In furnishing supply support to the Landing Force, the LANDLOGS system performs the following functions:

1. Acting through the Logistic Support Center, and each Ship's Logistics Control Centers, LANDLOGS manages the complete cargo handling process including movement, packaging, and staging of supplies for delivery to the using unit as pertains to supplies on each respective ship. Depending on the operational situation this function may also include actual delivery of supplies or the Landing Force itself may assume the delivery function. In any case, however, LANDLOGS traces the material handling process through to ultimate delivery to the user.

2. LANDLOGS monitors supply levels in the various supply points. Under most circumstances this means those stocks in ships engaged in support of the Landing Force. But it may also include operating, safety or emergency stocks held at other specially established stock points, including inactive, back-up stocks held by units of the Landing Force. Although stocks held by the Landing Force are not technically within the management control of LANDLOGS it is necessary to monitor stock levels at those points to provide a basis for related logistic decisions.

scope of LANDLOGS, and would be performed by the normal air request and air control system. On the other hand, requests for evacuation of captured enemy material, for movement of a detachment of troops for administrative purposes or for evacuation of wounded are within the scope of LANDLOGS. In furnishing transportation support during the amphibious assault, the LANDLOGS system provides the following functions:

1. Provides a central agency to coordinate and follow through on requests for transportation support missions.

2. Provides information on most efficient routes for logistic vehicles to use in carrying out their missions. This information does not include tactical information based on the enemy situation, which properly originates in the operational command and control system. The information does include a mathematical assessment which produces logistic vehicle routing to make best use of available resources.

3. Within the framework of assigned management authority, it allocates specific types of vehicles to tasks. LANDLOGS is also capable of assuming operational control of logistic vehicles, on order, for accomplishment of logistic tasks.

4. Maintain active lists of vehicles available, or suitable for logistic missions. This bank of information includes detailed performance characteristics of those vehicles that could be assigned logistic support roles.

5. Determines the most appropriate mode of transportation for accomplishment of logistic tasks and when needed, makes recommendations to the Commander related to optimum vehicle selection. Although the actual selection of a certain type vehicle may ultimately be dictated by other than logistic considerations, LANDLOGS determines the optimum vehicle based on most efficient employment of logistic resources.

6. Depending on the level of detail of operational control of logistic vehicles assigned to LANDLOGS, the system coordinates with and in general operates through the Helicopter Direction Center.

D. Medical

LANDLOGS coordinates the medical support function, except for those jobs done by corpsmen at the using unit level, and the jobs of stabilization and collection to prepare wounded for evacuation to more extensive facilities. Specific LANDLOGS functions in the medical support area are:

1. Coordinating the central casualty evacuation system for the amphibious operation. The most important operational element of this evacuation system is the medevac request system, which must be coordinated not only with the using units, but also with hospitals established in the ships and interservice long range medevac channels (such as those operated by the Military Aircraft Command)

connecting the amphibious objective area with medical facilities outside the theatre.

2. Furnishing control and coordination facilities for most effective application of medical resources. Normally this will consist of distribution of wounded to specific facilities best prepared to accept them at any given time depending on capability of the medical facility and on backlog of patients. This step and other decisions needed to control the flow of patients in medevac channels is accomplished by medical personnel assigned that specific function and operating within the LANDLOGS systems.

3. Coordination of requests for, delivery of and seabased support of mobile medical units which might be employed in an on-call role for movement to specific trouble spots.

4. Providing technical coordination from a medical standpoint of such problems as mass evacuation of civilians, or refugee handling.

5. Coordination of requests for and conduct of medical service functions, such as insect and pest control, fumigation or sanitation inspection support.

E. Service Support

Working as a coordinating agency for other established service organizations, and furnishing necessary support not

otherwise provided. LANDLOGS provides service support in the following areas:

1. Salvage and evacuation of unserviceable equipment.

2. Bath and laundry.

3. Disbursing, postal and exchange.

4. Movement or evacuation of captured enemy personnel and material, as requested.

5. Automatic data processing support of units not so equipped.

6. Messing, to include preparation and delivery of hot meals on request.

7. Within the priorities and policies established by the commanders involved, assistance in support of rest and recreation activities.

8. On request, conversion of raw-data input to printed periodic reports as a service for using units, to include personnel, logistic and other reports of an administrative nature.

A.7 LANDLOGS FUNCTIONAL AGENCIES

The network of functional agencies which make up the LANDLOGS subsystem consists of the Logistic Support Center (LSC) which is the primary overall logistic control agency, the Ship's Logistic Control Centers (SLCC) which are the LCS's functional arms in each of the support ships, and the Forward Logistic Control Centers (FLCC) which are the principal points of contact for logistic matters between the LSC and the supported battalions ashore. These are described in greater detail below, and their relationship is shown in Figure 4.1 on page 24.

A. Logistic Support Center (LSC)

1. General

a. The Logistic Support Center is the Amphibious Task Force Commander's and Landing Force Commander's primary agency for controlling and coordinating all logistic functions of the amphibious operation. Although the LSC is an agency directed by the Commander of the Amphibious Task Force, its primary purpose is to ensure optimum logistic support of the Landing Force in carrying out its share of the amphibious mission. Therefore, the LSC is manned by a joint group made up of representatives and specialists from both the Amphibious Task Force and Landing Force staffs.

b. When a Seabased Logistic Command is activated, the Logistic Commander employs the LSC as the primary means of exercising control of his component elements. These might consist of service and support units detached from the Landing Force, Marine units from force troops and units of the Amphibious Task Force specifically assigned to the operational control of the Logistic Command.

c. Ships in the amphibious objective area which are assigned a logistic support function are not appropriately placed under the control of the LSC, yet the LSC is the most knowledgeable agency regarding the best location, necessary movement, and replenishment needs of those ships. Therefore, the LSC prepares recommendations regarding employment of those ships, for the Commander, Amphibious Task Force, which he may execute through his operational command channels.

d. In situations where elements of the logistic structure are established ashore while others remain afloat, the scope of the LSC functions and those of the shorebased agencies will be determined on the basis of the specific situation. A functional parallel to this arrangement is the TACC-TADC relationship and the sharing of the air control job by landbased and seabased facilities. As in the air control situation, virtually any division of logistic control tasks can be made to work. The single absolute requirement is a clear understanding by all parties of roles and responsibilities.

e. As a general rule, the LSC will retain primary logistic control when support flows primarily from the seabase. In situations where the operation is based primarily on a landbased structure, the LSC might serve as an ancillary agency, complementing the landbased control structure. For analysis, however, it is convenient to consider the case where the seabase carries the entire logistic load, since this is the situation which imposes the most stringent requirements.

2. Functions of the Logistic Support Center

The Logistic Support Center performs five basic functions. It receives and processes requests for logistic support; provides inventory control for the Master Amphibious Inventory; coordinates actions of other agencies in logistic support matters; provides detailed and timely information to the Commander regarding logistic posture, and provides decision-assist recommendations on complex logistic matters requiring command decision. These functions are described in detail below.

a. Receives and processes requests for logistic support.

(1) The LSC is the single, central agency within the Amphibious Task Force which receives, processes and fulfills requests for logistic support from using units. The support requested might be in the category of supply, maintenance, transportation, medical or miscellaneous services. These categories are

discussed specifically later in this report. Processing of requests, like the other LSC functions, might be assigned to a shorebased facility in a mixed landbased-seabased logistic structure. The totally seabased orientation is addressed here.

(2) Once the LSC receives a request, it automatically acknowledges responsibility to follow that request through to ultimate delivery to using unit, or if that is not possible, to make other arrangements with the using unit. In no case, however, does the LSC dispatch support and assume it has been delivered. If the LSC seeks the assistance of another agency in fulfilling a request, it continues to retain reponsibility for action on that request.

(3) Requests for logistic support may be accommodated on four levels of precedence. These are:

(a) Routine.

All support requests, except those for medical support, are treated as routine unless otherwise specified. Precedence within the routine category is normally established by the Logistic Support Center and Ships' Logistic Control Centers on an as-received basis, unless using units indicate a preference to the contrary. Using units may indicate, along with their requests that one or another commodity (radio batteries, a certain type ammunition, or a certain spare part, for

example) should be placed at the head of its list of needs. This does not mean that a routine request, however, is ever handled ahead of a priority request or one of higher precedence.

(b) Priority.

This is the precedence assigned to those requests that require more than routine handling, but are not of a sufficiently pressing nature to call for emergency processing. Priority requests are usually those which, if not fulfilled within a reasonable time, will advance to emergency precedence. An example would be an early afternoon request for mortar ammunition when the need for the ammunition will not become pressing until nightfall, but the number of rounds in the hands of the user might not be sufficient to see him through the night. Thus, if the delivery has not been made before nightfall, an emergency situation might result. Another typical example of priority precedence would be a mission to evacuate certain captured material for examination by intelligence personnel, when the information is perishable or thought to be tactically significant.

(c) Emergency.

This is the precedence assigned to requests when loss of life or serious tactical consequence can occur if the mission is not fulfilled immediately. Since an emergency request

indicates an unusual tactical circumstance, such requests through logistic request channel must also be accompanied by a corresponding request through operational channels, providing a verification by the commander of the tactical unit originating the emergency request. This step is necessary because the decision to assign emergency precedence may call for action which has implications outside the logistic system. Therefore, this decision is specifically reserved for the tactical commander and not normally delegated to logistic agencies. This simultaneous request process facilitiates collection of information needed by the Commander as a basis for his decision, and at the same time allows the logistic processes to commence without delay.

(d) Flash.

This is the precedence reserved for grave situations in which success of the amphibious mission is at stake, and when even emeregency missions must be moved aside. As in the case of emergency missions, it is not within the purview of the logistic system to establish a Flash precedence; instead, the request must be passed simultaneously via the operational channels reflecting the specific decision of the tactical commander involved. On the rare occasions when it becomes necessary to assign flash precedence to mission requests, other actions through the LANDLOGS system will normally be stopped, to ensure that no lower precedence action interferes with a flash precedence mission.

(4) Requests for logistical support may be divided into four basic types according to the method of handling:

(a) Real-time requests

These are the conventional requests, passed from using units, through the Forward Logistic Control Centers to the LSC. These requests specify the type support desired and contain other necessary details.

(b) On-call support

These are requests, submitted in advance of their need, whose desired time of accomplishment is not known at the time of the request. On-call support might be applicable when special advance preparations are needed, or when for other reasons an unacceptable processing delay would result.

(c) "Push" support

These are implied requests. This technique might be used when consumption rates can be accurately predicted. Examples include combat rations and water. In those situations, supplies could be automatically "pushed" to using units without specific requests by the unit for that particular support. Decision to push support is made on a temporary basis for a local

situation and for specific items of support or classes of supply; it is not otherwise automatic.

(d) Scheduled support

These are requests collected in advance of their anticipated need, based on predictions of future requirements. Once support is scheduled in this manner, changes are made by exception; that is, the schedule is followed, unless specific requests are made for changes.

b. The LSC provides inventory control for the Master Amphibious Inventory.

(1) The Logistic Support Center exercises primary management control of the Master Amphibious Inventory, which is the primary tool for control of supply in the objective area. This inventory, prepared during the LOADLOGS phase is essentially a compilation of the individual ships' current inventories, although it does not necessarily contain the same detail regarding physical location of cargo within the individual ships. The Master Amphibious Inventory serves as the master file for control of the individual ships' inventories and for control of the overall amphibious supply system inventory.

(2) The LSC performs the full range of normal inventory control functions. Issues and losses are posted against the master file to yield running stock levels. These levels are

continually compared with established reorder levels and average expenditure rates to predict reorder dates and quantities. Assuming automatic data processing is used in this step, algorithms are applied which take into account pipeline delays and best courses for selection as reorder points.

c. Coordinates the actions of other agencies in logistic support matters.

Channeling of wounded to medical facilities in the seabase is appropriately a function of a medical regulating network. The movement of wounded, however, requires coordination within the overall logistic system. This is a process in which the LSC can provide the essential coordination function. In other situations, a mass evacuation operation, or one involving movement of large numbers of refugees, might encompass medical service effort, resupply, scheduling of transportation, engineer effort and security. Such a situation would demand highly effective coordination of effort, a task logically falling to the LSC.

d. Provides management information reporting to the Commander.

The Logistic Support Center is the repository of a large amount of data which it collects in the normal conduct of its operations. By carrying out inventory control and processing of logistic requests, for example, the LSC has available

to it detailed information on usage rates of individual items or classes of supply. Stock levels can be compared to reorder levels and estimates made of days of supply remaining, based on a variety of projected usage rates, or other variables. Individual unit expenditures in any class of supply or item of equipment can readily be extracted. Ship, or other unit effectiveness can be examined in terms of its response times, numbers of non-deliveries, or in relation to performance of other, similar units. Information of this type is readily available depending upon the degree of detail with which the Commander desires to monitor operation of the logistic system.

e. Provides decision-assist recommendations on complex logistic matters.

The level of effectiveness of this function depends directly upon the degree of advancement of the automatic data processing system used to support the LANDLOGS subsystem. A relatively advanced tactical shipboard installation, adequately programmed, can greatly enhance productive management of logistic resources through application of operations research techniques. For example, optimum routing of helicopters based at a variety of sites, making stops at a variety of other sites can be routed in such a way as to gain maximum productivity per flight hour. Queueing techniques can be used to gain maximum productivity in situations which must mesh internal flow of cargo with external traffic control of delivery vehicles. Simulation models can be used to test proposed changes in tactical plans, to analyze time-distance factors, cargo flow rates, and a wide range of other logistic problems.

This is a highly promising area in tactical ADP employment and one in which only limited work has been done.

B. Ship's Logistic Contrc' Centers (SLCC)

1. The SLCC's are the principal functional arms of the LANDLOGS subsystem, operating under the direct management control of the Logistic Support Center (LSC). Where the LSC is the primary agency for controlling and coordinating all logistic operations of the seabase, each individual Ship's Logistic Control Center actually carries out a major share of this job, especially in resupply of the Landing Force. It is the task of the SLCC to receive requests from the LSC, to physically locate and manipulate the cargo, to stage it and launch it by boat or aircraft enroute to the using unit, keeping the LSC informed of its action.

2. The SLCC's control each ship's Cargo Management System and thus determine to a major degree the total effectiveness of the shipbased resupply structure.

C. Forward Logistics Control Centers (FLCC)

The FLCC is the central point within the Landing Force which interfaces with the Logistic Support Center. This is a streamlined facility manned by the LSC to assemble, assign priorities and relay logistic support requests from using units to the LSC. The facilities and functions of the FLCC are as elaborate as the

Landing Force Commander desires to make them, but the LANDLOGS subsystem is tailored to operate effectively with virtually no record-keeping or administrative processing at the FLCC. In situations in which an elaborate logistic structure is established ashore, however, with less reliance on seabased support, correspondingly more administrative processing of logistic support requests may be performed by the FLCC or other shorebased agencies.

D. Landing Force Logistic Coordination Center (LFLCC)

In certain situations the Landing Force Commander may choose to establish an LFLCC to provide specified logistic control functions ashore. The operations of an LFLCC, like the entire concept of a seabased logistic support, can be adjusted incrementally to any level appropriate to the individual situation. In a MAF size operation which might incorporate a shorebased logistic structure with a logistics commander established ashore, the LFLCC might be an extensive facility, embracing all the functions carried out by LANDLOGS in a seabased mode. On the other hand, the LFLCC might be a small facility whose sole functions are to manage a combat base of emergency supplies and to coordinate the support requests from an individual FLCC. Within the LANDLOGS concept, therefore, the LFLCC may be viewed as a provisional agency, to which the LANDLOGS and its other functional agencies are adapted as necessary to create a single integrated amphibious logistic system.

E. Logistic Support Center (Rear) (LSC Rear)

The LSC (Rear) which was activated earlier when the operation entered the transit phase, serves as the rear-area arm of LANDLOGS, and operates under management control of the LSC. Its main purpose is to deal with long lead-time logistic problems that require coordination in the rear area and to furnish direct representation of the Amphibious Task Force Commander in situations where such action is needed. Activation of an LSC (rear) is not vital to LANDLOGS operation, but might be useful in situations involving highly complex replenishment or other logistic problems. In some cases, the LSC (Rear) might consist only of a liason officer working in the offices of the fleet logistic staff. In other cases, where complex technical supply problems are involved, or where the amphibious operation has unusual logistic characteristics, the LSC (Rear) might be more extensive.

A.8 LANDLOGS RELATED AGENCIES

Several of the standard agencies of an amphibious operation have a direct relation to the operation of the LANDLOGS system, yet are not within the sphere of Logistic Support Center control. These are listed and discussed below.

A. CATF Operation Center

This is the principal facility through which the Commander of the Amphibious Task Forces exercises tactical

command. In some cases, as in amphibious exercise ESCORT LION II in September 1970, the Amphibious Task Force Commander and Landing Force Commander may elect to establish a joint operation center, which becomes a single point from which commands are given either to task force or landing force units. Regardless of the particular arrangement selected by the Commander, the Logistic Support Center operates as a specialized logistic control facility, acting for the Commander. This means that Logistic Support Center and Task Force Operation Center operations are closely related.

B. Tactical Air Direction Center

In situations where the Logistic Support Center is undertaking to coordinate large scale logistic operations, spanning a number of elements such as air cover, air evacuation, air drop of cargo or other fixed wing aircraft activity related to logistics, close liaison must be maintained with the Tactical Air Direction Center or other specially designated air control agencies.

C. Helicopter Direction Center

In most situations the Commander's air control system will include a Helicopter Direction Center to deal with command and control matters related to helicopter operation. This center facilitates a close functional relationship with the Logistic Support Center.

A.9 LANDLOGS OPERATION

A. The Logistic Support Center is the principal controlling element in the LANDLOGS subsystem. Requests for support, made to the LSC by using units comprise the principal step that activates the system and generates transactions. The system is also activated by command requirements for logistic information, decision-assist or coordination of the activities of other agencies. LANDLOGS operation in the support-request mode is described in detail below.

B. A key step in the request process is the assignment of an identifying task number. When the request is initially received by the LSC and before it is introduced into the LANDLOGS system, the LSC assigns that specific request an identifying task number, which then becomes an integral part of the description of the basic mission to be performed. This number is used throughout the process without change or modification. Using units may originate requests for support in any of the five types provided by the LANDLOGS system: supply, maintenance, transportation, medical or service support.

1. Supply Requests

a. Initial requests by landing force units for supply support may be assembled and coordinated ashore in several ways, depending on the size of the landing force and the particular

landbased logistic structure being employed. In a MAU-sized landing force, requests from individual users (company, platoon, patrol, firebase, etc.) will be assembled and passed on by a Forward Logistic Control Center (FLCC). The FLCC will work directly with the LSC afloat, and the FLCC itself will be of minimum size adequate to receive requests, resolve problems of priority in the battalion, and relay the requests to the LSC.

b. In larger operations involving more than one battalion, several FLCC's may be conceivably established. These individual FLCC's may work directly with the LSC afloat, or a Landing Force Logistic Coordination Center (LFLCC) may be established ashore to coordinate the supply requests from the individual battalions. Except for unusual circumstances, however, the LFLCC will only monitor requests from the FLCC to the LSC, since additional processing at an LFLCC represents an administrative delay that is unnecessary if the LSC is functioning as a primary logistic control agency.

c. Considerable flexibility is possible in the supply request structure. For example, when a logistic command has been activated by the Landing Force, the LFLCC might function afloat in the LSC until the tactical situation calls for its displacement ashore, or it might remain afloat throughout the operation if that proves to be a more satisfactory arrangement. In any event, the action taken by the LSC upon receipt of a supply request is essentially the same. This process is illustrated in simplified form in Figure A.3. Upon receipt of a supply request at the LSC, a task number is assigned

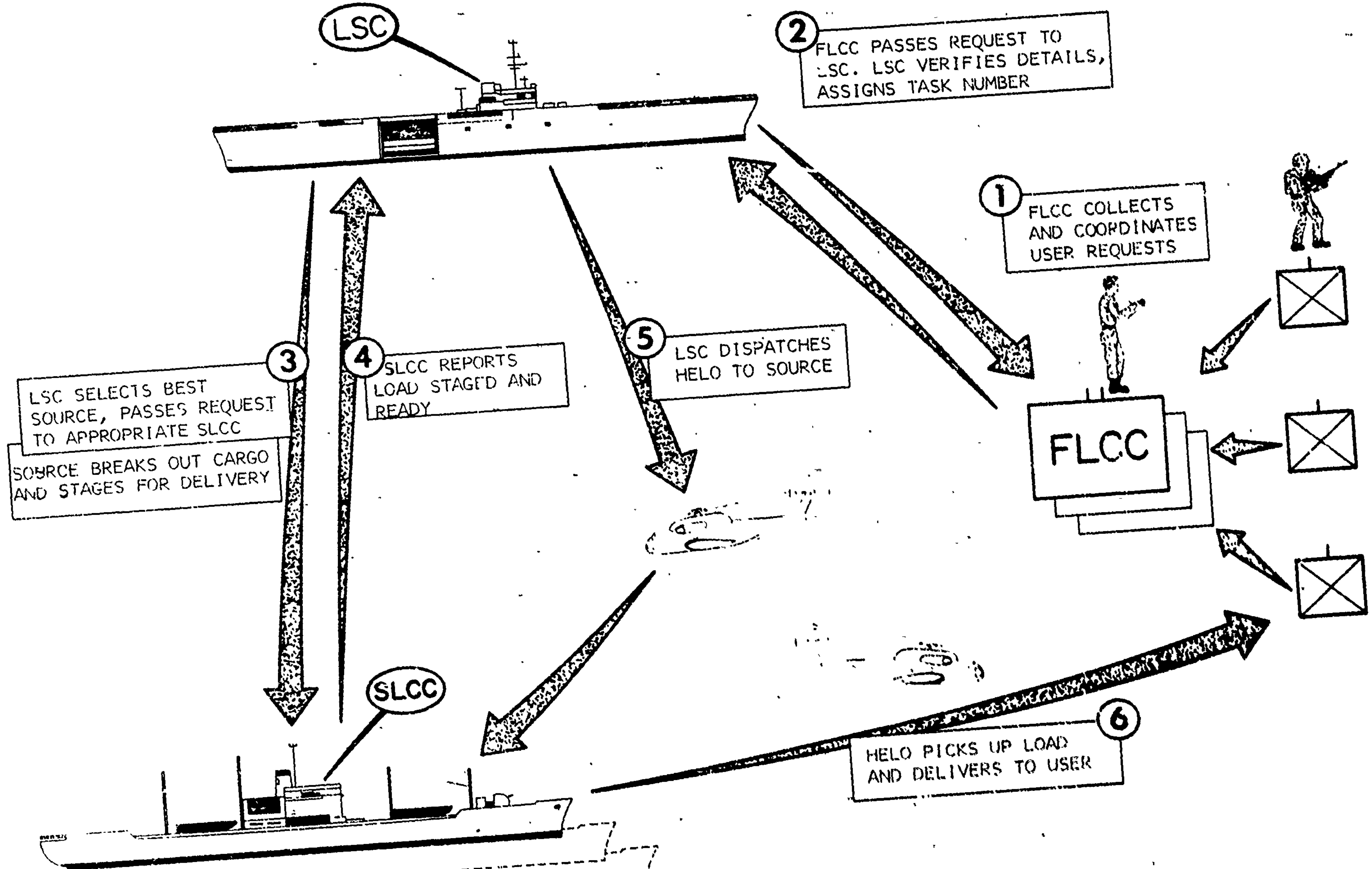

FIGURE A.3
LANDLOGS SUPPLY REQUEST FLOW

and this information is passed to the FLCC to facilitate identification of the mission as it passes through the system. The LSC next queries the Master Amphibious Inventory for prospective sources for the desired items. In case there is more than one source among the ships of the Amphibious Task Force, the optimum source is selected.

d. The request is then passed to the SLCC in the selected source, along with any special instructions necessary. In passing the request it is still identified by the same task number originally assigned upon receipt at the LSC. Depending on the state of advancement of the data processing system serving LANDLOGS, the SLCC may send periodic reports to the LSC advising status of the request within the ship. The next key step, however, is the report by the SLCC that the particular task number is staged and ready for pickup and delivery. Details relating to processing of the request within an individual ship are described in detail in the following chapter devoted to the ship's Cargo Management System.

e. When the LSC is advised that a particular task number is staged and ready, an appropriate transfer vehicle is dispatched to pick up the load and deliver it to the user. In most situations the transfer vehicle will be a helicopter, but it could be a surface craft wherever boats are considered more appropriate.

f. If the LSC has been assigned operational control of a block of working helicopters dedicated for logistic support, the actual dispatching of the airplane will be performed by the LSC. If the LSC has no helicopters under its control, the mission request is passed to the Helicopter Direction Center for accomplishment. In

either situation, the LSC retains primary responsibility for tracking the request throughout the process until the user acknowledges that he has received it. There are several reasons for this single responsibility. First, it establishes one clear channel through which the FLCC can transact all its logistic business. Second, it reduces the possibility of system breakdown which can easily occur when the responsibility passes from one agency to another. And third, as the fleets acquire progressively more capable shipboard data processing systems the LSC becomes more logically the single agency with the capability to monitor and control the detailed supply process.

g. The single logistic responsibility in supply requests does not mean that the LSC is necessarily responsible for the air control of helicopters, for example. It does mean that the LSC must be aware of the progress of the request, so that if a disruption occurs in the flow, the LSC is able to initiate action ot correct it or cause the flow to resume by an alternate means.

h. After the SLCC reports a load staged and ready, and after the appropriate transfer vehicle has been dispatched, the next step is a report to the LSC by the SLCC that the load has been picked up and is on the way to the user. The SLCC has now closed out its action regarding that task number. Under most circumstances the LSC will advise the FLCC that the load is on the way. The process closes out when the load is delivered to the user and the FLCC reports that the load has actually arrived at its destination. At that time the originally assigned task number is retired from the list of active tasks being controlled by the LSC.

i. The specific means of communicating the various messages t! . oughout the process will vary greatly depending on the particular hardware and system in use as will the techniques for documenting the key steps. The functional process, however, will remain essentially the same for a hybrid manual-automatic system, or for a highly advanced, fully automatic system that might be deployed later in the 1975-19̃5 period.

2. Maintenance Requests

a. The main focus of this study is cargo management, thus detailed examination of seabased equipment maintenance support is outside the study's purview. However, since the mobile seabase concept calls for integration of the total amphibious logistic effort, steps taken to solve the cargo management problem have an immediate bearing on the other basic logistic problems.

b. Already implicit in the supply system is the capability of users to initiate requests for support. The same channels serve equally well for requests for maintenance support. These channels connect the main functional agencies of the LANDLOGS subsystem: the battalions ashore (FLCC), the Logistic Support Center (LSC) and the Ships' Logistics Control Centers (SLCC). Action taken within each of the agencies in dealing with maintenance support problems, however, varies somewhat from the supply sequence. The maintenance process is shown in Figure A.4, and explained in detail below.

c. Seabased shops to support the Landing Force are established through shared use of shops in individual ships, through

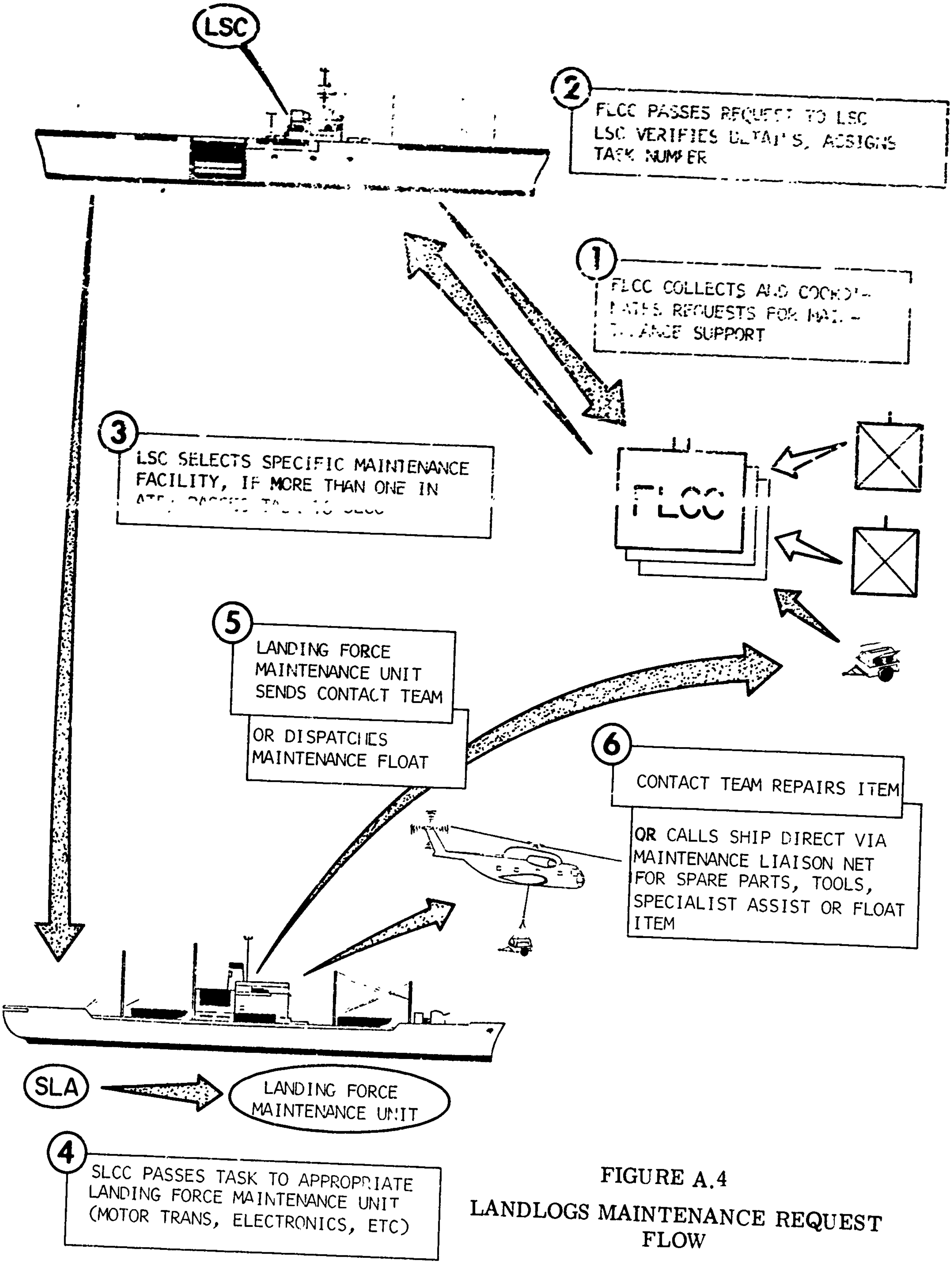

FIGURE A.4

LANDLOGS MAINTENANCE REQUEST FLOW

shipboard employment of organic repair vans of units of the Landing Force, or combinations of the two. Any of these arrangements require that spare parts be available and readily accessible to landing force representatives or others who might be operating seabased shops, but it is not essential that the spares be controlled through the same channels as the LANDLOGS resupply. Since spare parts, especially electronics spares, may constitute a major percentage of line items (not weight or cube) of the landing force supply stores, it may prove more convenient to control those items within the maintenance structure itself.

d. Under this arrangement the specific maintenance organization aboard ship controls the stowage, issuing and reordering of its own spares. For example, in the case of electronics maintenance in a certain ship, the Landing Force will have a representative in charge of its maintenance work, with an organization consisting of those Marines of the Landing Force who would, in a classical operation, have performed their maintenance functions ashore. The individual in charge of the shipboard maintenance operation, a landing force electronics maintenance representative in this example, will also assume responsibility for spare parts control to support his own operation. He issues out of his own stocks as necessary to perform the electronics maintenance support job. Since individual SLCC's have the capability to introduce supply requests into the LSC request structure, the head of a landing force electronic maintenance facility reorders via his own ship's SLCC to the LSC as required to maintain desired stock levels. This technique requires that supply personnel working in the LSC hold current supply documents to facilitate communication of requisitions, but the LANDLOGS

data base is not required to maintain inventory control of all individual maintenance spares.

e. For shipbased maintenance to function, a means must exist to extend technical service to trouble spots in the beachhead area. Highly mobile and specially equipped contact teams, operating from the seabase are the principal means of doing this. Either on a scheduled basis, or in response to a request for assistance, these contact teams visit using units. Depending on the type of maintenance being performed (electronics, motor transport, engineer, etc.), the teams will carry kits of hand tools, a limited stock of small high usage spares, and sufficient documents to allow the team to initiate requisitions to its parent SLCC for spare parts. If a team makes a visit in response to a specific request, it might also carry several spares or special tools that appear likely to fit the needs of the mission. In still other cases, the team might carry serviceable, built-up items from the maintenance float inventory to replace the unserviceable item at the site of the using unit. To the extent that the maintenance and supply posture of the Landing Force will allow, contact team maintenance provides the best customer service when it employs unit distribution of replacement float items. Such a technique tends to minimize the time using units must operate short between turn-in of an unserviceable item and issue of a float item. However, unit distribution of this type also calls for a larger inventory of float items held by the Landing Force; thus, a balance must be selected for each operation between most efficient maintenance support, and realistic float inventory levels.

f. Upon arrival at the site of a using unit, a contact team will repair the unserviceable item with the team's portable repair kit; pick up the unserviceable item and order a replacement item from the maintenance float inventory; or request via its own SLCC that other necessary parts or specialist personnel be dispatched to the site. In some situations it may prove more efficient to attach small contact teams semi-permanently to units with a predicted high volume of maintenance needs, to perform limited second echelon maintenance and to assist in communicating requests for special assistance.

g. In all cases the contact teams operate through the normal LANDLOGS request network, passing requests for supply support, transportation, additional maintenance help and other service, through the most convenient FLCC, to the LSC. In some circumstances, it may be desirable to activate a liaison net which contact teams may use to communicate directly with their parent maintenance organization aboard ship. In that case, team transportation and other support is provided on the basis of requests from the SLCC to the LSC.

3. <u>Transportation Requests</u>

a. Flowing in from using units via the LSC request network, transportation request will normally be channeled by the LSC to other agencies which have transportation under their operational control. For example, a request for administrative movement of a small detachment of troops from one position ashore to another, would probably be passed from the FLCC to the LSC where the request would be assigned a task number. The LSC would then

continue to monitor the progress in fulfilling the request. This process in shown in Figure A.5.

b. In this way, as in the case of supply requests, the LSC acknowledges the responsibility to track the mission all the way through to accomplishment. This does not mean that the LSC span of authority is extended to control of aircraft or boats assigned elsewhere. It does mean that the system provides for a single agency which is responsible to reschedule, re-request or make other appropriate arrangements for the user in case the normal process is interrupted. In the administrative troop movement mentioned above, it the assigned aircraft for some reason are not able to complete the mission in its entirety, the LSC by recognizing this can go back to the HDC with an additional request, or through liaison with the using unit determine what alternative action is appropriate. In short, this role of LANDLOGS in the transportation request process is one of cross-check against interruption or breakdown of the regular transportation system.

4. Medical Requests

The entire area of medical support of the Landing Force has been the subject of extensive analysis in other studies, which take into account tactical and medical problems far outside the scope of this report. LANDLOGS performs the best service in the medical request role by adapting to medical control structures already being developed separately. This adaptation is a simple process. The total LANDLOGS structure is based on effective liaison, data collection,

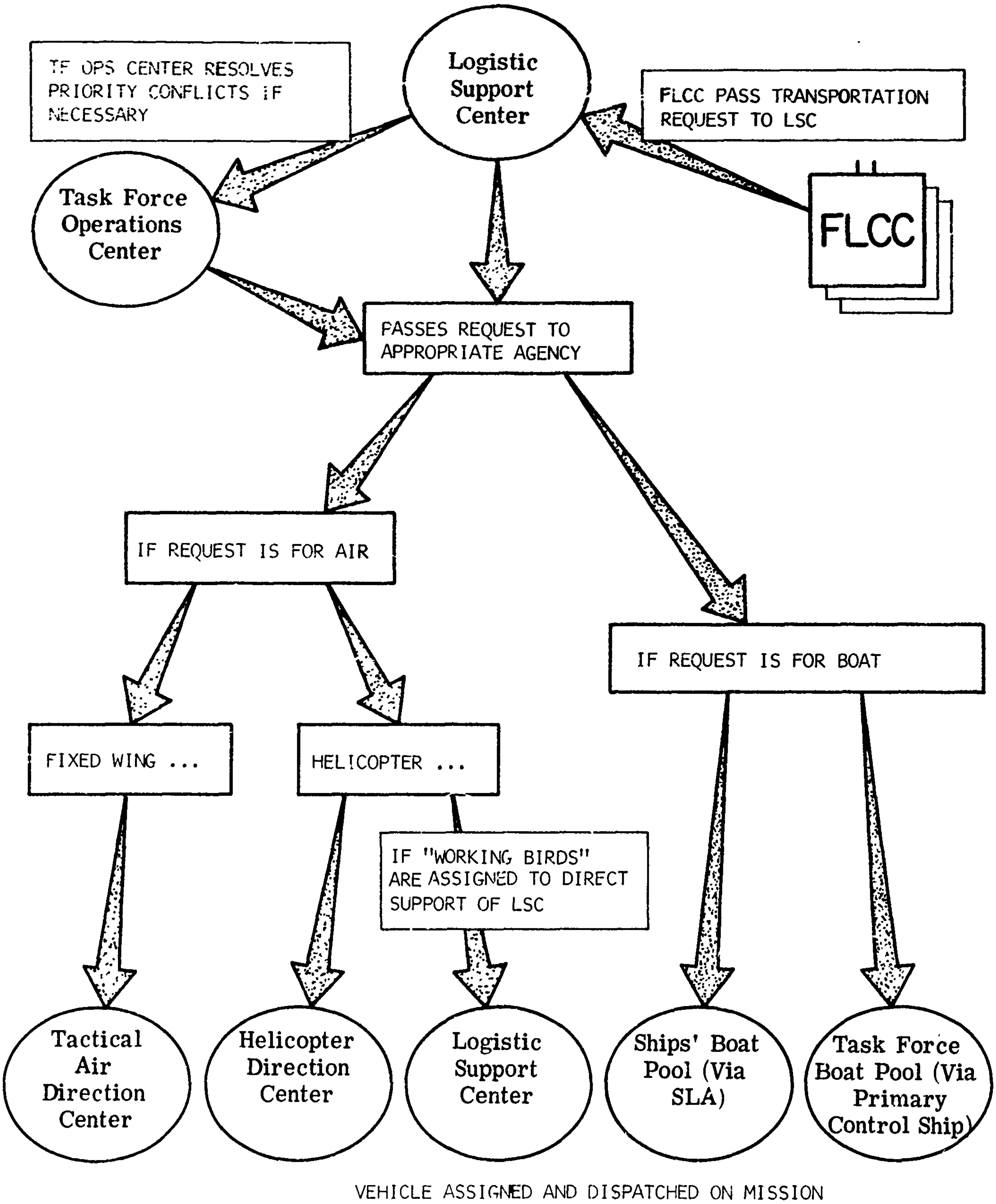

FIGURE A.5

LANDLOGS TRANSPORTATION REQUEST FLOW

coordination and record-keeping. The structure is deliberately designed to allow adjustment to a wide variety of specific problems. Thus, the system makes available to the medical control structure its request network, its ability to provide or arrange for all types of logistic support on request or on schedule, and its ability to coordinate activities between other operational agencies. The future medical support structure can therefore be developed solely on the basis of its operational needs, without artificial constraints stemming from problems of request processing, activity coordination or transportation request scheduling.

5. Service Support Requests

Requests for service support are passed by the requestor through the normal request channel via the Forward Logistic Control Center to the Logistic Support Center. At that time an assessment is made of the nature of the support needed and a decision is made as to the agency best equipped to respond to the request. In cases of requests for movement or evacuation of captured enemy personnel or material, for example, the request would be treated as a request for transportation, but seabased intelligence units would be altered to receive it. Requests for service related to disbursing, mail, or exchange matters would be relayed to appropriate shipbased service elements of the Landing Force. Thus, generally speaking, service is provided by the same agency as in the more traditional type operation, except that those agencies in the seabased concept are located aboard ship, and the requests from the Landing Force are relayed through the Logistic Support Center, which ensures that the requests are passed to the appropriate agency, and necessary coordinating steps are taken.

APPENDIX B

DISCUSSION OF SEABASED LOGISTIC TECHNIQUES IN RELATION TO THE LANDING FORCE

B.1 SEABASED LOGISTIC SUPPORT: GENERAL

A. Under current doctrine, the first few days of an amphibious assault mark a general unloading of ships and the beginning of a major buildup ashore of supplies, equipment and logistic support personnel. Supplies for a month or more are deposited ashore and then distributed through a landbased system to the individual user. Depending on the size and duration of the operation, repair shops are set up ashore with stocks of spare parts. Transport, service support and medical facilities are built up. This shorebased logistic complex is costly in personnel, vehicles, and equipment to protect, store, move and dispense the supplies and services, but more important, it comprises a major encumbrance to the mobility of the Landing Force.

B. In amphibious operations based on the seabased logistic concept, general unloading never takes place. The ground elements land only those items of supply and equipment which contribute directly to the amphibious mission. Backup vehicles and materials handling equipment remain aboard ship. Replenishment flows directly

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from the ships to the using units. Troops ashore maintain only minimum stocks of ammunition, food and water. Helicopters deliver artillery ammunition immediately alongside the individual pieces so that crews break down the loads and serve the guns without additional handling of ammunition. The Landing Force takes ashore only the vehicles, such as tanks, which it needs for combat maneuver, and special communication, command and control and reconnaissance vehicles. Shipboard shops repair unserviceable vehicles and equipment. With this expanded support from the sea, the landing force can reduce its shorebased supply structure, shorebased shops and repair facilities, shorebased maintenance floats and stores, and can consequently release the sizeable number of troops who operate and protect such facilities.

C. Besides reducing the non-combat overhead ashore, seabased logistics also promises to improve the quality of logistic support. Elimination of the extra handling steps ashore reduces the loss, damage or breakage of material on its way to engaged units. Material awaits delivery in protected stowage in holds of ships rather than in open dumps ashore, exposed to the elements and to enemy action. Weapons, radios, electronics gear and vehicles are repaired in well-lighted, protected and generally more desirable working conditions aboard ship.

D. The new logistic concepts also offer gains in versatility of the Amphibious Task Force/Landing Force team. For example, the ability to operate from a mobile seabase might be particularly valuable in an operation in an area that is highly unstable politically,

that could at any time call for prompt and complete extraction of the Landing Force for reasons apart from the military mission. Another example would be an operation where the local political situation militates against buildup of any military facility ashore other than the specific concentration of combat troops needed to accomplish the military mission.

E. While seabased logistics enhances the versatility and combat power of a landing force, it tends to place the ships of the Amphibious Task Force in a more exposed posture. To support a landing force from the sea, certain key support ships must remain in the vicinity of the amphibious objective area throughout the operation. This constraint magnifies the submarine threat and increases the exposure of the Task Force to other threats. As helicopter and landing craft performance improve in the future, however, this problem becomes less severe. With greater speed and range in ship-to-shore transfer vehicles, ships of the mobile seabase can move farther to sea, decreasing their exposure to attack from ashore and increasing their area of maneuver.

F. Since seabased logistics gains its major advantage from thin supply stocks ashore, the threat to the Landing Force of being cut off for several days from the mobile seabase poses a problem. The Landing Force can, however, provide a measure of insurance against this contingency. Emergency combat bases can be established ashore as a safeguard in case the link to the ships is broken. The composition of such bases might vary from a small dump containing a few days food

and ammunition to a large, complex facility with medical, maintenance, and extensive resupply capability. The larger facility tends to lessen the advantage of seabased logistics, since it calls for landing logistic support troops, supplies and equipment, diminishing the key advantage of a logistic seabase. However, this is an operational decision of the commander, who must select an optimum balance between the burden of a logistic buildup ashore and assurance of uninterrupted logistic flow.

G. It is important to keep in mind, at least for the near future, that total logistic support from the sea is a goal rather than an immediately attainable objective. But this is not to say that steps cannot be taken at an early date that will bring substantial gains in mobility and freedom of action to the landing force. For example, a number of amphibious ships in the fleets today have extensive shop and repair facilities which can take a share of the maintenance load off a landing force. To the extent that this is practical, this means fewer personnel to land and support and a decrease in facilities and supplies on the beach to encumber the mobility of the Landing Force. The increasing reliability of helicopter operation tends to make ship-based medical facilities a more effective answer to the problem of landing force casualties than elaborate shorebased hospital facilities. In the area of landing force resupply, improved selective unloading features of the newer amphibious cargo ships can make direct ship-to-user supply flow progressively more promising. Similar situations prevail in a number of other support functions, any or all of which can be landbased or seabased. These

range through supply, transportation, maintenance, medical and service support functions.

H. Unlike some advances in tactics and doctrine, the adoption of seabased logistic techniques need not necessarily be disruptive. Many of the essential elements are already in common practice. The operation in both fleets of the Amphibious Ready Groups, with their Special Landing Forces embarked are cases in point. In Vietnam the Special Landing Forces have made over fifty amphibious landings where virtually all logistic support facilities remained aboard the ships of the Amphibious Ready Group during the entire operation. Although operational scope, distances, and cargo volume in those operations were considerably less than those envisioned for a full scale mobile logistic seabase operation of the future, they furnish an important precedent and a fund of practical experience which relates directly to the more advanced concepts.

I. Marines of the III Marine Amphibious Force, in 1968 and 1969, developed a number of advanced logistic techniques which also contribute to this fund of practical experience. In the northern provinces of Vietnam, intense combat operations of reinforned regiment size were launched, carried and supported totally by helicopter. using rear area logistic support points. On some days, cargo throughput was as high as 500 tons, delivered to 20 to 25 different units [1]. Although those were "dry land" operations, the tactical

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1 Dalby, M. C., Combat Hotline, (U), Marine Corps Gazette, Volume 54, No. 4, April 1969, UNCLASSIFIED.

and logistic situation and the time-distance factors closely parallel those which might be anticipated in a mobile seabase operation of the future.

B.2 TRANSITION TO SEABASED SUPPORT

The decision to employ a mobile seabase is not necessarily an "either-or" choice. The level of seabased logistics employed may be at any point between a totally landbased and a totally seabased orientation. The actual level selected depends on two major considerations. The first of these is the tactical situation which can make landbasing certain logistic functions desirable, even though the seabased capability exists. The second consideration is the state of development of the various hardware and systems which make a mobile seabase possible. These determine the capability for selective unloading of cargo, for identification and location of cargo in the ships of the seabase, for seabased repair and maintenance of the equipment of the Landing Force, and for suitable ship-to-shore transport means. These capabilities are expected to improve progressively through the 1975-1985 period. Both tactical and hardware considerations are discussed more completely in the following paragraphs.

A. The Tactical Situation

Although seabased logistics offers enormous tactical advantage in many situations, there are also circumstances where

total seabasing of the landing force's logistic support does not present the most effective tactical arrangement. Listed below are several examples of widely varying sets of conditions which could make selected landbasing of support tactically preferable:

1. An amphibious objective area in a region of unusual climatic conditions which tends to limit reliable daily replenishment of individual units by helicopter. In this case, it might be necessary to maintain a limited replenishment supply structure ashore, employing mixed seabased and landbased supply techniques.

2. Time constraints on the availability of specialized amphibious shipping. In this case certain specialized vessels might be available in the objective area for the early portion of the assault, but are needed elsewhere immediately thereafter. Therefore, the decision might be made to landbase replenishment stocks or equipment repair facilities.

3. Enemy capabilities which impose an extremely high threat to helicopter operations. In this case, it might be necessary to develop the ground situation in the objective area to an additional degree to reduce the threat to helicopter operations and create a more permissive environment for their employment.

4. An amphibious objective area which already has a well developed petroleum source and distribution system in

operation. In this case, the tactical scheme might exploit this capability, and develop a logistic structure based on shorebased fuel support.

B. Hardware and Systems Considerations

Although tactical considerations may, at times, cause the Commander to base selected logistic elements ashore, generally it is to the substantial advantage of the Landing Force to exploit whatever degree of seabased support the Amphibious Task Force is capable of providing. At the present time, through innovation and adaptation of existing equipment, the Amphibious Task Force is able to shoulder a share of the support. As time passes, it is logical to expect this capability to increase considerably with improving hardware and systems. A number of programs are already in varying stages of advancement which may make direct and important contributions. Examples of these are the LKA-113 Class ship, with greatly improved selective cargo handling features; the LCC-19 Class command ship with advanced communication and data processing capability; the LHA, with a wide range of new capabilities from aircraft operation and maintenance to advanced cargo handling; near-term prospects of helicopters able to lift 18 tons and future prospects of 25 to 30 ton-lift machines; air cushion surface craft to complement the helicopter and offer a new measure of speed and versatility in the ship-to-shore movement; and advancing computer techniques, with programs to compress the time-consuming t. 'k of ship loading for amphibious operations. Ships

of the LKA-113 Class are already in operation in the fleet. As the other new capabilities become operational they represent incremental steps toward a total seabased capability.

B.3 LANDING FORCE STRUCTURE UNDER VARYING SEABASE OPTIONS

A. Detailed quantification of the impact of seabased logistics on the composition of the Landing Force is outside the scope of this study. A general frame of reference, however, is useful to identifying orders of magnitude of the seabased logistics job expressed in terms of troops and vehicles required ashore at varying levels of seabased support. Estimates of these numbers can be developed by first identifying the key logistic functions which might be performed from a seabase, by next drawing a number of logical mixes of these functions, and finally by "costing out" each mix in terms of estimated numbers of landing force troops and vehicles ashore.

B. The mix of seabased/landbased support functions for a specific concept of operations could range between two extremes: a totally landbased logistic structure and a totally seabased one. As a practical matter, actual mixes will probably be selected at intermediate points, reflecting decisions on supply, transportation, maintenance, medical and service support options. Examples of these sub-elements which might be shifted to a seabase are:

1. Management control of supply levels.
2. Small arms ammunition replenishment.
3. Artillery ammunition replenishment.
4. Combat ration and water replenishment.
5. Hot food preparation and delivery.
6. Electronics spare parts replenishment.
7. Replenishment of all other classes of supply to using units.
8. Electronics equipment repair.
9. Medical facilities and evacuation control.
10. Vehicle and other equipment repair.
11. Unit record-keeping.
12. Transportation resources (reliance on seabased helicopters as opposed to landing motor vehicles for landing force self-transport).
13. Service functions such as fumigation, decontamination, insect and pest control, bath, laundry, disbursing, postal, administrative data processing, construction and repair exchange.
14. Equipment salvage.
15. Dispensing of fuel and petroleum products.

C. There are thousands of different arrangements of the functions listed above which would each result in a slightly different logistic structure. It is convenient, therefore, rather than to inspect each of those arrangements individually, to describe a sliding scale between a totally seabased orientation on one hand and a totally land-based one on the other. The scale should not attempt to address the full range of permutations and combinations conceivable, but should

instead trace a single typical transition sequence. For purposes of this analysis, such a scale is defined in terms of six successive layers of seabased support. These are:

1. Level Alfa - Logistic support to the Landing Force is provided by the shorebased complex. This is the conventionally supported operation, with virtually all its own logistic structure established ashore by the Landing Force. This concept envisions a thirty-day supply mount-out, followed by an additional thirty days of supply held by service units as mount-out augmentation until arrival of the first resupply shipment. Although this situation may include some limited use of floating dumps, the general sequence is that the amphibious ships disembark the Landing Force as the assault begins, and follow this by a general unloading, upon completion of which the ships depart the objective area.

2. Level Bravo - Logistic support to the Landing Force is provided primarily by the shorebased complex, with some assist from the seabased structure. This level is the same as Alfa, except that doctors, hospital, and medical service facilities are not landed; daily combat ration replenishment is provided from the seabase, as is preparation of hot food, depending on the tactical situation.

3. Level Charlie - Logistic support to the Landing Force is provided primarily by a shorebased structure, but with substantial assist from the seabase. This level is the same as Bravo, except that daily small arms ammunition replenishment is provided from the seabase; a substantial share of motor transport maintenance is

performed aboard ship or by contact teams; few, if any, motor transport vehicles are landed; and point-to-point transport needs are supplied by units' organic transportation or helicopters.

4. Level Delta - Logistic support to the Landing Force is provided primarily from the seabase, but with heavy reliance still placed on certain shorebased elements. This level is the same as Charlie, except the number of organic personnel and cargo transport vehicles is sharply reduced; all ammunition including that for the artillery is replenished from the seabase directly to the user; Beach Group and bulk fuel units are not landed; shortage in point-to-point transport is compensated by increased helicopter support; the majority of equipment repair of all kinds is performed aboard ship or by contact teams.

5. Level Echo - Logistic support of the Landing Force is almost totally provided by the seabase, although some of this support may flow through surface means in addition to helicopter transport. In this level no general unloading takes place. Prescribed loads are minimized, anticipating daily or multiple daily individual unit replenishment. No motor vehicles are landed except for combat vehicles such as tanks, certain unique communication vehicles, and selected engineer items essential for preparation of artillery positions or other direct combat needs.

6. Level Foxtrot - Logistic support of the Landing Force is totally from the seabase. This is the extreme case of employment of seabased logistics. The Landing Force is stripped to direct combat units,

and those units are in turn stripped of individuals who do not have an immediate combat function. The only elements of logistic structure ashore are a limited number of emergency dumps of essential supplies, held at a one to four-day level; those dumps are used only in emergency cases where normal seabased support is interrupted. Although theoretically feasible for larger units at some point in the future, this level of seabased support will likely be feasible in the near-term period only for smaller scale operations of approximately MAU size.

B.4 QUANTITATIVE FORCE LEVELS

A. To illustrate the changes that might occur in a landing force as logistic support shifts from shore to a seabase, typical force structures are developed for the six levels described above. These force structures are described in terms of the number of troops and vehicles which are landed for each level. The forces examined include typical Marine Amphibious Unit (MAU) and Marine Amphibious Brigade (MAB) size forces. The following material discusses the effects of seabasing on the number of personnel and vehicles landed.

B. Personnel Levels

1. Personnel levels ashore for the MAU and MAB size assault are shown in Tables B.1 and B.2. These personnel levels reflect estimates of the number of men ashore required by each unit, operating with the indicated degree of seabased support.

TABLE B.1

TROOPS ASHORE IN A LANDING FORCE OF MAU SIZE (BLT)

Element	Seabased Logistic Level					
	Alfa	Bravo	Charlie	Delta	Echo	Foxtrot
Command Element	430	430	430	430	410	410
Infantry Bn.	1200	1190	1190	1170	1150	1150
Artillery Bty. (Reinf)	250	240	240	220	220	220
Tank Plt. (Reinf)	40	40	40	40	40	0
Amphib. Tractor Plt. (Reinf)	80	80	80	80	80	80
Engineer Plt. (Reinf)	50	50	50	50	40	40
Det. Service Bn.	150	150	150	150	0	0
Det. Shore Party Bn.	80	80	80	80	0	0
Bulk Fuel Plt. (-)	50	50	50	0	0	0
Det. Medical Bn.	60	10	10	10	10	10
Motor Trans Plt. (Reinf)	60	60	0	0	0	0
Det. Naval Beach Grp	140	140	140	0	0	0
TOTAL	2590	2520	2460	2230	1950	1910
% of Alfa Level	100	98	95	87	75	73

TABLE B.2

TROOPS ASHORE IN LANDING FORCE OF MAB SIZE (RLT)

Element	Seabased Logistic Level					
	Alfa	Bravo	Charlie	Delta	Echo	Foxtrot
Command Element	670	430	420	420	420	420
Infantry Reg.	3760	3730	3730	3720	3700	3700
Artillery Bn. (Reinf.)	850	[illegible]	830	760	760	760
Tank Co.	140	140	140	140	140	0
Amphib. Tractor Co. (Reinf.)	310	310	310	270	270	270
Engineer Co. (Reinf.)	200	200	200	200	200	200
Det. Service Bn.	350	340	340	0	0	0
Det. Shore Party Bn.	160	160	160	70	0	0
Det. Supply Bn., FSR	390	270	260	80	70	70
Det. Engineer Bn. FMF	240	240	240	110	0	0
Det. Medical Bn.	140	20	20	20	20	20
Truck Co (Reinf),FMF	160	160	130	40	0	0
Det. Naval Beach Grp.	340	340	340	90	30	30
TOTAL	7700	7170	7130	5920	5610	5470
% of Alfa Level	100	93	92	77	72	69

The entries reflect general reductions in troops ashore at the various levels and should not be interpreted as the total personnel embarked for the assault, since some personnel remain afloat to perform tasks such as maintenance or supply. At each level, except Foxtrot, landing force firepower remains unaffected. In level Foxtrot, no tank or anti-tank elements are landed.

2. Examination of Tables B.1 and B.2 shows that personnel numbers for levels Alfa, Bravo and Charlie are not radically different, and reflects the relatively small gains from seabasing medical and certain service support functions. For levels Delta, Echo and Foxtrot, however, the number of troops ashore decreases considerably, generally reflecting the increasing gains that accrue as vehicles are left aboard ship.

C. Vehicle Levels

1. The quantity of vehicles landed, expressed in square feet, is shown in Tables B.3 and B.4 for the MAB and the MAU assaults. The number of vehicles landed for each element at each level was estimated based on the requirements for logistic support and troop mobility at each level, and was converted to square feet.

2. The effect of a shift towards increase seabased support is more evident here than in personnel levels. Vehicle square shows a sharp decrease in both the MAB and MAU assaults for

TABLE B.3

VEHICLES ASHORE IN A LANDING FORCE OF MAB SIZE (RLT)

(expressed as sq ft of vehicle space)

Element	Seabased Logistic Level					
	Alfa	Bravo	Charlie	Delta	Echo	Foxtrot
Command Element	9,300	9,300	9,300	8,200	5,600	5,600
Infantry Reg.	13,270	13,270	13,270	12,680	6,130	6,130
Artillery Bn. (Reinf)	23,680	23,680	23,660	19,430	8,400	8,400
Tank Co.	9,160	9,160	9,150	8,080	7,050	0
Amphib. Tractor Co. (Reinf)	25,480	25,480	25,480	25,480	25,480	25,480
Engineer Co. (Reinf)	6,630	6,630	6,630	6,630	3,820	3,820
Det. Service Bn.	10,780	10,780	10,780	0	0	0
Det. Shore Party Bn.	3,750	3,750	3,750	1,100	0	0
Det. Supply Bn. FSR	5,760	5,130	5,130	3,550	0	0
Det. Engineer Bn., FMF	21,500	21,500	21,500	12,420	12,420	12,420
Det. Medical Bn.	2,730	0	0	0	0	0
Truck Co (Reinf), FMF	19,490	19,490	15,370	5,660	0	0
Det. Naval Beach Grp.	5,730	5,730	5,730	2,460	0	0
TOTAL	157,260	153,900	141,530	105,690	68,900	61,850
% of Alfa Level	100	98	95	64	44	38

TABLE B.4

VEHICLES ASHORE IN A LANDING FORCE OF MAU SIZE (BLT)
(Expressed as sq ft of vehicle space)

Element	Seabased Logistic Level					
	Alfa	Bravo	Charlie	Delta	Echo	Foxtrot
Command Element	6,510	6,510	6,510	4,860	3,910	3,910
Infantry Bn.	3,780	3,780	3,780	2,740	1,740	1,740
Artillery Bty. (Reinf)	6,540	6,540	6,540	4,730	2,310	2,310
Tank Plt. (Reinf)	3,170	3,170	3,170	2,810	2,440	0
Amphib Tractor (Reinf)	6,240	6,240	6,240	6,240	6,240	6,240
Engineer Plt. (Reinf)	2,830	2,830	2,830	2,230	1,630	1,630
Det. Service Bn.	3,750	3,750	3,750	2,530	0	0
Det. Shore Party Bn.	1,850	1,850	1,850	1,650	0	0
Bulk Fuel Plt. (-)	1,170	1,170	1,170	0	0	0
Det. Medial Bn.	1,530	0	0	0	0	0
Motor Trans Plt. (Reinf)	7,080	7,080	0	0	0	0
Det. Naval Beach Grp.	3,300	3,300	3,300	0	0	0
TOTAL	47,750	46,220	39,140	27,790	18,270	15,830
% of Alfa Level	100	97	82	59	39	33

levels Delta, Echo and Foxtrot, where support is principally seabased. This decrease in vehicles landed is, of course, compensated for by an increased reliance on transportation from the mobile seabase for troop mobility and ship-to-user logistic support.

B.5 SUMMARY

The trend toward seabased logistics not only promises to provide greater mobility for the Landing Force ashore, but may result in a more effective utilization of amphibious shipping as well. In particular, the greatly reduced amount of space required for vehicles as seabasing is increased may allow the reduction of one (or more) ships from the Amphibious Task Force. This will depend, of course, on many of the factors mentioned in this section.